371

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
CROPS RESEARCH DIVISION

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SUGAR BEET RESEARCH

1957 REPORT

Compiled by Sugar Beet Section

ADMINISTRATIVELY CONFIDENTIAL[1]

1/ This is a progress report of cooperative investigations containing data, the interpretation of which may be modified with additional experimentation. Therefore, publication, display, or distribution of any data or statements herein should not be made without prior written approval of the Crops Research Division, A.R.S., U. S. Department of Agriculture, and the cooperating agency or agencies concerned.

CR-2-58

FOREWORD

This report on sugar beet research is prepared primarily to present investigations conducted by the Sugar Beet Section that have been strengthened through support from the Beet Sugar Development Foundation. The report also serves to fulfill the provisions of the Memorandum of Understanding between the Crops Research Division, A.R.S., U.S.D.A. and the Beet Sugar Development Foundation, as well as the provisions of the Cooperative Agreements of the Crops Research Division with the Farmers and Manufacturers Beet Sugar Association and with the Union Sugar Division of Consolidated Foods Corporation. The Beet Sugar Development Foundation is a third party to both of these Cooperative Agreements. The contribution received through the Beet Sugar Development Foundation, under the Cooperative Agreement with the Farmers and Manufacturers Beet Sugar Association, is included in Foundation Project 26, and that received from the Union Sugar Division comprises Foundation Project 29.

The individual projects as set up by the Beet Sugar Development Foundation have been indicated in each of the Parts of this report. The aims and objectives of the Foundation Projects are rather broad, and under the several projects through which support is received, almost all of the research work conducted by the Sugar Beet Section is strengthened in some manner by contributions from the Beet Sugar Development Foundation. This combined report encompasses most of the basic and applied research conducted by the Sugar Beet Section in 1957.

Cooperative field tests conducted by State Experiment Stations, the Farmers and Manufacturers Beet Sugar Association, and Agricultural Departments of Sugar Companies have added greatly to the report. The cooperation, as it applies, has been indicated under separate Parts of the report.

TABLE OF CONTENTS

TABLE OF CONTENTS

HIGHLIGHTS OF ACCOMPLISHMENTS

by Dewey Stewart

New Inbreds, Improved Varieties, and Productive Hybrids.--During 1957 the Sugar Beet Section made available to the Beet Sugar Development Foundation 25 new strains of sugar beets for seed increase under the provisions of a Memorandum of Understanding with the Crops Research Division, A.R.S., U.S.D.A. These strains representing new inbreds, monogerm "O" types and their male-sterile equivalents, and breeder seed of synthetic varieties have been described on pages 5-10 of this report. The acceptances of the proposals for seed increase by the Foundation through company members or through their seed-producing subsidiaries have been given on pages 11-13. It will be noted that company members of the Foundation received, for immediate use, small quantities of seed of these new developments to explore their potential value in company breeding programs while seed increases are being made. The seed production in 1957 of 33 strains furnished to the Foundation in 1956 has been given on pages 14 and 15. For descriptions of these strains, see pages 6-19 of the 1956 Report.

A procedure has been set up whereby company members of the Foundation may make special requests to staff members of the Sugar Beet Section for genetic material thought to be of value in their breeding program. Through this procedure, company members of the Foundation were provided with 10 genetic strains in 1957, 23 in 1956, and 43 in 1955.

One of the encouraging things in the development of new curly-top-resistant monogerm lines as presented by F. V. Owen is their relatively high sucrose content. The monogerm line SLC 122, which was conspicuous for its high curly top resistance at Jerome, Idaho, in 1957, showed sugar percentage equal to that of the better sugar type multigerm lines. Based on various chemical analyses made by Myron Stout, selections are being made in this monogerm line to bring about further improvement in quality.

Results of 13 tests that were conducted to evaluate new Breeder Seed of synthetic varieties developed in a program of breeding for resistance to leaf spot and black root have been given in Summary Tables on pages 128, 129, and 130. In these tests of 1957, which were conducted in various sugar beet growing areas of the humid region, leaf spot and black root were not serious factors influencing the average relative performances of the varieties. In general, the new synthetic varieties did not show improvement in root yield under the conditions of the tests, but it is of interest to note that the new developments tended to give higher sucrose percentage than US 401.

Progress has been made in combining resistances to leaf spot and curly top, as indicated by the results given in Part VIII of this report, but improvement in root yield must be brought about before the synthetic varieties now available can be considered as potential replacements of varieties now in use in areas subject to damage from curly top and leaf spot. However, accomplishments in breeding to combine resistances to leaf spot, curly top, and black root can be expected from the hybridizations and reselections made by F. V. Owen, A. M. Murphy, and J. C. Overpeck under curly top exposure; and by J. O. Gaskill, G. E. Coe, and G. J. Hogaboam under leaf spot and black root exposure.

The excellent performances of bolting-resistant hybrids in California have been given in Part III of this report. It should be pointed out that the basic parental materials for the production of these hybrids are inbred lines NB_1, NB_2, NB_3, and NB_4, which were developed by J. S. McFarlane. Through breeding work it has been possible to develop male-sterile equivalents for use as female parents in the production of hybrid seed. It will be noted from the descriptions of the varieties, as given on page 61, that some of the hybrids are single crosses but that hybrids 663H1 and 663H2, which gave gross sugar yields ranging from 9 to 35 percent over US 75, are three-way hybridizations. These bolting-resistant inbred lines, and particularly their male-sterile equivalents, have great potential value as seed bearers in hybrid seed productions for California conditions when a complementary line or variety is used as a pollinator.

The performances of numerous monogerm strains and hybrids have been given in Parts II, III, VII, VIII, and X of this report. It is gratifying to note that monogerm types in most of the tests conducted over a wide geographical region have been reported as giving performances equal--or in some tests superior--to the multigerm variety now in general use in the area. However, much work is yet to be done before acceptable monogerm varieties are available for all sugar beet districts. It must be recognized that the monogerm variety should carry resistance to disease and factors for adaptation now found in the multigerm varieties that are to be replaced. For progress that is being made in developing monogerm strains of diverse cytoplasm and high sucrose percentage, attention is directed to the report by V. F. Savitsky in Part X.

Breeding for Quality under High Levels of Fertility:--The more general appreciation of the fertilizer needs for sugar beets is certainly one of the reasons for improvement in the national average yield. Nitrogen is the nutritive which normally produces the largest increase, but it requires great care to avoid production of roots of low quality. There is definite need for the development of a variety of sugar beets bred for quality production when grown under high levels of fertility. Studies conducted by LeRoy Powers and J. W. Dudley in cooperation with the Colorado Agricultural Experiment Station give results indicating the ill effect of nitrogen when in excess. They are also making studies of genetic principles whereby varieties may be produced that are tuned for luxury feeding. The results of their investigations have been reported in Part VI.

Probably of greatest importance in the studies reported by these investigations is a comparison between the mean sucrose involving an F_1 hybrid and its inbred parents, 50-406 and 52-307. In this hybrid the percentage sucrose of the F_1 is significantly higher than that of either parent. Heterosis for sucrose percentage is definitely expressed in the F_1 hybrid involving these two inbred lines, as indicated in experiments conducted in 1956. In the test of 1957, the percentage sucrose for the F_1 hybrid between the same two inbreds was again higher than that of either parent. Under conditions of the tests of 1956 and 1957, heterosis for percentage sucrose was demonstrated in this hybrid. It seems that the heterosis for percentage sucrose in some F_1 hybrids involving inbred lines of sugar beets may not be uncommon. This fact may prove to be of considerable economic importance in the production of beet sugar. In further analysis

of the experimental data, it was concluded that the ability of the F_1 to produce higher percentage sucrose at the higher fertility level is partially or completely dominant. Further analysis shows that the ability of the F_1 to react as the inbred parent 50-406 in respect to high potential percentage sucrose production and as the 52-307 parent in being able to maintain percentage sugar on the higher fertility level results in the heterosis noted for the F_1 on the high fertility plots.

Virus Yellows is a Threat to Quality Production of Root and Seed.--The objectives of virus yellows investigations at Salinas, California, conducted by C. W. Bennett and J. S. McFarlane, included basic studies on the disease and its control through the development of resistant varieties. In 1957 experiments were conducted to determine effects of virus yellows on yield of sugar beets under controlled conditions at the Salinas field station, using more than 300 varieties, selections, and inbreds of sugar beets.

Yield reductions in the May planting were more severe than in the December planting. Losses for 165 inbreds ranged from 9.3 to 65.8 percent; and for 92 varieties and selections, from 10.8 to 49.1 percent. The reduction in sucrose in sugar beet varieties inoculated with virus yellows ranged from 0.36 to 1.40 percentage units. The mean of 12 varieties included in a field test showed a reduction of 0.85 percentage units.

In a test conducted in the greenhouse, it was found that yellows and curly top brought about approximately the same reduction in seed yield, the actual reduction being 63.3 for yellows and 65.7 for curly top. Only 5 of the 50 plants inoculated with both viruses produced seed, and the yield of seed from these plants was less than 10 percent of the yield of seed from healthy plants.

In a field test using plots 12-1/2 feet long and 4 rows wide, it was found that inoculations with virus yellows in March resulted in an average reduction in seed yield of 44 percent. Later inoculations in May resulted in some reduction in yield, but the reduction was not as great as that resulting from the earlier inoculations. There was no evidence that virus yellows influenced the germinations of the seed produced. From the results of this test and from other data, it is evident that virus yellows delays bolting but probably the disease does not greatly influence the number of plants that produce seed. More results are needed before final conclusion may be reached with respect to the damage likely to be caused by virus yellows in commercial varieties of sugar beets being grown for seed, but evidence thus far indicates that losses may be appreciable if infection occurs before plants begin to produce seedstalks.

Nematode Resistance Breeding Shows Promise.--Screening tests for nematode resistance have been continued by Charles Price with seedling populations at the Salinas station, in an attempt to find tolerant individuals when grown in soil heavily infested with the organism. All promising individuals are given a second nematode exposure. The plants showing tolerance to the organism in both tests are brought to seed production. The progeny of selected individuals are now under test to determine the extent to which heritable differences have been established. The report on pages 87-90 gives results of extensive screening tests to locate factors for nematode resistance in species of Beta and to determine the host range of the nematode.

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Of special interest are the results of a field test conducted by C. H. Smith in Utah under severe nematode exposure. In this test, as reported in Part V, the selections made for nematode resistance by the American Crystal Sugar Company gave excellent growth in comparison with unselected material. The strains arising from nematode-resistant selections made in the screening test at the U. S. Agricultural Research Station, Salinas, have also shown a level of tolerance that is encouraging. Among inbreds in the test, 6503-13C2, developed by J. S. McFarlane, showed outstanding foliage vigor, although it had not been selected for nematode resistance. This can be taken as further indication that the reaction to the nematode is under genetic control.

Inoculation Techniques for Disease Resistance Breeding.--Wastage from rotting of almost mature sugar beet roots due to Rhizoctonia solani is very serious and seems to be on the increase in some areas. Since this soil-inhabiting pathogen attacks many species of crop plants and satisfactory control of the disease through crop rotation and other field practices seems improbable, the development of resistant varieties seems to be the most feasible method of preventing losses. The development of a dependable method of exposure to the pathogen, whereby the occurrence of heritable differences in disease reaction in the sugar beet can be detected, is basic to an effective program of breeding for ~~resistance for~~ Rhizoctonia resistance.

In cooperative research conducted with the Colorado Agricultural Experiment Station, significant accomplishments have been reported by J. O. Gaskill and V. G. Pierson in Part VI, pages 119-123. In special comparisons of harvest results of 1957, two trends stand out: (1) Three selections for Rhizoctonia resistance, furnished by the Great Western Sugar Company, as a class were significantly higher in root yield under severe exposure to the pathogen than the parental varieties; (2) in the material under study, resistance to Rhizoctonia solani tends to be associated with resistance to the black root pathogen, Aphanomyces cochlioides.

These findings give promise that a tolerant reaction to Rhizoctonia solani is heritable and that there may be an association of resistance to R. solani and to the black root pathogen, A. cochlioides.

Progress has been reported by C. L. Schneider (pages 185-187) in the development of methods of evaluating new breeding material for resistance to the black root organism, Aphanomyces cochlioides. Using standardized dosages of zoospores of the pathogen to give a desired severity of exposure, the relative disease ratings of polycrosses obtained from greenhouse tests with seedling progenies grown in 6-inch clay saucers have shown concordance with root weights taken as indication of black root tolerance in replicated field tests conducted at three locations under natural soil infestation.

This inexpensive greenhouse test has been used to eliminate from field evaluations the most susceptible strains and polycrosses arising in the breeding program for black root resistance. The method of inoculation had been used to bring about reliable disease exposure in stands of seedlings to give selections for the improvement in resistance to the damping-off phase of black root.

Strains of the curly top virus differ strikingly in their ability to cause damage in sugar beet varieties. Of special interest in the Intermountain area is the extreme virulence of Strain 11 of the curly top virus originally isolated from a sugar beet grown in Idaho. Inoculation tests with Strain 11 at Jerome, Idaho, have been given on page 22. The results of 1957 confirm the findings of 1956 and indicate that the varieties which are not severely damaged by the prevailing strains of the virus brought to the field at Jerome by natural infestations of the vector suffer severe damage from Strain 11. If Strain 11 should become the dominant one in an area, the varieties that have given high level of protection in the past would show severe losses.

Polyploidy.--European breeders have given emphasis to polyploidy as a means to new levels of productivity in the sugar beet. The report by Helen Savitsky, page 192, by G. E. Coe, page 183, and by J. S. McFarlane, page 41, indicate that progress is being made in establishing American varieties of sugar beets on the tetraploid level. The report by J. W. Dudley, page 115-118, gives a technique for screening colchicine treated populations and segregating progenies for levels of ploidy.

If polyploidy as a means to improvement is explored with American varieties, many tetraploids must be produced and evaluated. Furthermore, it should be pointed out that tetraploid strains are only a means to triploidy, which is thought to be the most favorable level of ploidy for productivity. The ultimate goal of commercial polyploid varieties will require intensive cytological work to obtain tetraploid lines and extensive breeding and field testing to find complementary combinations of diploids and tetraploids for the production of productive triploids.

P A R T I

INBREDS, HYBRIDS, AND BREEDER SEED OF SYNTHETIC VARIETIES

PROPOSALS FOR SEED INCREASE

Items Proposed for Seed Increase
May 24, 1957

Distribution of Seed for Increase
1957-1958

Seed Production of 1956 Proposals
(See 1956 Report, Part I)

PROPOSED RELEASES FOR SEED INCREASE
BY THE BEET SUGAR DEVELOPMENT FOUNDATION
1957

Current designation, brief description, and estimate of seed available will be given for each item proposed for release. These inbred lines, breeder seed, etc. were developed in breeding research conducted by the Sugar Crops Section in cooperation with:

Colorado Agricultural Experiment Station
Michigan Agricultural Experiment Station
Minnesota Agricultural Experiment Station
New Mexico Agricultural Experiment Station
Farmers and Manufacturers Beet Sugar Association
Beet Sugar Development Foundation

The items are presented under the Station or Center of development which will indicate the general direction of breeding of the various groups of items. All seed weights are estimates of seed production made far in advance of harvest.

I. U. S. Sugar Beet Field Laboratory, Salt Lake City, Utah.

Multigerm Self-Fertile Inbred

Item 1. CT5 (formerly line 157) . . . . 1/2 pound
Curly-top resistant. The release made in 1956 consisted of combining 3 sub-lines of CT5. The 1957 release will consist of a Mendelian male-sterile (aa) backcross from a more rigid sugar selection of 10 different sub-lines.

Monogerm Self-Sterile

Item 2. SLC 34 . . . . 1/2 pounds
Curly-top resistant, Jerome, Idaho, selection. Code 5052 developed by Dr. V. F. Savitsky

Item 3. SLC 35 . . . . 1-2 pounds
Curly-top resistant, Jerome, Idaho, selection. Parental population of 35 MS mm, developed by Dr. V. F. Savitsky

Item 4. SLC 35 MS mm, Code 9333 (Janash cytoplasm). 30-100 grams

Monogerm Self-Sterile

Item 5. SLC 36-0 (aa backcross) . . . . 1/2 pound
Curly-top resistant. This population should segregate for 50 percent Mendelian male sterility. From it one may produce F_1 hybrids useful as pollinators in 4-way hybrids.

Monogerm Self-Fertile

Item 6. SLC 123 . . . . 1-2 pounds
High in curly-top resistance; vigorous. An inbred from SLC 101 X US 22/4. Code 5888, developed by Dr. V. F. Savitsky

Item 7. SLC 124 . . . . 1-2 pounds
High in leaf-spot resistance, from US 216 X SLC 101. Code 329, developed by Dr. V. F. Savitsky.

Item 8. SLC 125-0 (aa backcross) . . . . 1/2 pound
High in curly-top resistance.

Item 9. SLC 125 MS mm (F_1 hybrid to SLC 125) . . 1-2 pounds
This new line was outstanding in curly-top resistance at Jerome, Idaho, in 1956 but was less vigorous than several other lines. At Salt Lake City it showed good sugar percentage and the roots were large in proportion to the tops. Hybrids with SLC 125 are being produced in 1957. It would seem advisable to await combining ability data before extensive propagation.

Monogerm Lines for Combining Ability Studies

In 1956, 40 monogerm lines, each segregating for Mendelian male sterility, were furnished to the Amalgamated Sugar Company and the Utah-Idaho Sugar Company for a cooperative program of work. Each of the 40 lines is being reproduced separately at Salt Lake City. After combining ability studies are completed, desired lines can be made available.

At Nyssa, Oregon, Dr. Rush has been successful in growing over-wintered progenies from each of the 40 lines, all of which are being rogues to aa male steriles and crossed to a multigerm pollinator (US 35 aa X Deming 52-644). The new hybrids should be of interest for combining ability studies.

The Utah-Idaho Sugar Company attempted also to make hybrids with the 40 respective monogerm lines, using the multigerm variety (sugar selection SL 202) as the pollinator. Unfortunately the stands from the monogerm lines were not adequate. Some of the lines were represented by thin stands. These are being rogues to recessive aa male steriles, and a special effort is being given to preserve the fastest seed-producing types. These hybrids will be useful for cooperative work in recovering earlier seed-producing monogerm segregates in the next generation.

Additional Material Developed by Dr. V. F. Savitsky

Self-fertile and self-sterile curly-top-resistant monogerm lines will be tested again at Jerome, Idaho. Twenty-four selected, self-fertile monogerm lines, good in curly-top resistance, are being tested at four locations: Jerome, Idaho, Twin Falls, Idaho, Salt Lake City, Utah, and Shelley, Idaho. Seed or roots of any of these lines which appear to be outstanding in performance may be made available.

II. U. S. Agricultural Research Station, Salinas, California.

Breeder Seed for the Production of Elite

Item 10. C7507 . . . . 1 pound

This monogerm inbred is the increase of an S_4 line from US 22/3 X SLC101mm. It has excellent bolting resistance, medium vigor, and good seed setting ability. Although it is not Type O, no pollen producers have been observed in hybrids with male steriles. The inbred lacks curly top resistance. The inbred has shown above average sugar content. Hybrids involving this inbred are included in 1957 variety tests.

Item 11. C7507HO . . . . 1 pound

This male sterile represents the second backcross to C7507.

Item 12. C7515 . . . . 1 pound

This monogerm inbred is the increase of an S_5 line from NB1 X SLC101mm. It has excellent bolting resistance, good vigor, and good seed setting ability but is lacking in curly top resistance. It is a good Type O. Limited testing has indicated good combining ability.

Item 13. C7515HO . . . . 1/2 pound

This male sterile represents the fourth backcross to 7515.

Item 14. C7507H1 . . . . 1 pound

This is the F_1 monogerm hybrid MS of C7515 X C7507. It has good vigor and bolting resistance. Information will be available soon on flowering, seed setting ability, seed size, and male sterility. Three-way hybrids using US 75 and C586 as pollen parents are being produced this season. Small quantities of this seed will be available this fall for use in variety tests.

Item 15. C7508 . . . . 1 pound

This is a mildew resistant,multigerm inbred which has been selected from the S_2 (US 22/3 X NB1). It has excellent bolting resistance. Its curly top resistance is intermediate between US 56/2 and US 75. Vigor only fair. Good Type O.

Item 16. C7508HO . . . . 25 grams

This male sterile represents the fourth backcross to C7508.

<u>Elite Seed for Production of Stock Seed</u>

Item 17. C787 . . . . 10 pounds

This is a bolting-resistant selection from US 75 (C368). Preliminary testing indicates that it is similar to C368 in yield and sugar. Bolting information will be available in June. Companies which plan to continue the use of US 75 may wish to build up a supply of stock seed of this new selection.

III. Breeding for Improvement in Leaf Spot and Black Root Resistance:

Plant Industry Station, Beltsville, Maryland
Michigan Agricultural Experiment Station,
East Lansing, Michigan
Minnesota Agricultural Experiment Station,
Southern Substation, Waseca, Minnesota
Colorado Agricultural Experiment Station
Fort Collins, Colorado

<u>Breeder Seed - Multigerm</u>

Item 18. SP 5713-0 . . . . 12-15 pounds

A synthetic (SP 5613-0) obtained from the interpollination of 5 clones of mothers producing polycross progenies which were outstanding in

performance under severe leaf spot exposure and moderate black root exposure on the Plant Industry Station. Leaf spot resistance is excellent. SP 5713-0 is related to SP 5460-0. (See West Coast 5415 or Fort Collins Accession 2067.)

Item 19. SP 5714-0 . . . . 25 pounds

A synthetic (SP 5614-0) obtained from the interpollination of 6 clones of mothers producing polycross progenies which were outstanding in performance under severe leaf spot exposure and moderate black root exposure on the Plant Industry Station. Leaf spot resistance is excellent. Under severe leaf spot exposure, SP 5614-0 was significantly above US 400 in sucrose percentage.

Item 20. SP 5716-0 . . . . 12-15 pounds

A synthetic (SP 5616-0) obtained from the interpollination of 4 clones of mothers producing polycross progenies outstanding in performances under severe leaf spot exposure and moderate black root exposure on the Plant Industry Station. SP 5616-0 is a synthetic with robust foliage and high in root yield. In leaf spot and black root resistance, SP 5616-0 was better than US 400 at the Plant Industry Station.

Item 21. SP 571850-00 . . . . 1 pound

Botrytis (storage rot) resistant selections at Fort Collins, Colo., from strains that are resistant to leaf spot and black root. SP 571850-00 was produced from a pooling of roots selected for Botrytis resistance from 4 related strains which arose from Fort Collins Accession 1192. (West Coast 1275, SP 50A3-0)

<u>Breeder Seed - Monogerm</u>

Item 22. SP 5733-0 . . . . 1 pound

A monogerm synthetic obtained from the interpollination of 6 selfed progenies of mothers producing polycross progenies approximately equal to US 400. Leaf spot resistance is equal to US 400.

Item 23. SP 5734-0 . . . . 1 pound

Pooling of polycross seed of outstanding mother selections. A type of mass selection to give a productive monogerm variety.

IV. Breeding for Leaf Spot and Curly Top Resistance:

Plant Industry Station, Beltsville, Maryland
U. S. Sugar Beet Field Laboratory, Salt Lake City, Utah, and Twin Falls, Idaho
New Mexico Agricultural Experiment Station, State College, New Mexico

Multigerm

Item 24. SP 571-0 . . . . 1 pound

From selections made at New Mexico State College by Professor Overpeck out of SP 551-0 which was outstanding in his test in 1956. SP 551-0 has good leaf spot resistance.

Item 25. SP 57102-0 . . . . 1 pound

From selections made at the Plant Industry Station out of SP 55107-0 which was resistant to curly top. Leaf spot resistance is good.

From: James H. Fischer, Secretary, Beet Sugar Development Foundation
July 25, 1957

UTILIZATION OF USDA SEED RELEASES, 1957 1/

1. U. S. Sugar Beet Field Laboratory, Salt Lake City, Utah.

Item 1. CT5 (formerly line 157) - will not be increased through the Foundation but the available quantity will be shared by the Utah-Idaho Sugar Company and the Holly Sugar Corporation.

Item 2. SLC 34 - will not be increased through the Foundation, but the available quantity will be shared by the Utah-Idaho Sugar Company, Holly Sugar Corporation, Great Western Sugar Company, Amalgamated Sugar Company, American Crystal Sugar Company, and Spreckels Sugar Company.

Item 3. SLC 35 - will not be increased through the Foundation, but the available quantity will be shared by Holly Sugar Corporation, Great Western Sugar Company, Amalgamated Sugar Company, American Crystal Sugar Company, and Spreckels Sugar Company.

Item 4. SLC 35 MS mm, Code 9333 (Janash cytoplasm) - will not be increased through the Foundation but will be shared by Holly Sugar Corporation, Amalgamated Sugar Company, Great Western Sugar Company, American Crystal Sugar Company, and Spreckels Sugar Company. If the quantity of seed available is too small, one of the companies will increase a quantity of it.

Item 5. SLC 36-0 (aa backcross) - will not be increased through the Foundation, but will be shared by Utah-Idaho Sugar Company, Holly Sugar Corporation, Amalgamated Sugar Company, Spreckels Sugar Company, American Crystal Sugar Company, and Canadian Sugar Factories, Limited.

Item 6. SLC 123 - will not be increased through the Foundation but will be shared by Great Western Sugar Company, Utah-Idaho Sugar Company, Holly Sugar Corporation, Amalgamated Sugar Company, and Spreckels Sugar Company.

Item 7. SLC 124 - This seed will be increased by the Farmers and Manufacturers Beet Sugar Association. Before the seed is distributed for increase, Utah-Idaho Sugar Company wishes to receive 20 grams and Holly Sugar Corporation wants 50 grams.

Item 8. SLC 125-0 (aa backcross) - will not be increased through the Foundation but will be shared by Utah-Idaho Sugar Company, Holly Sugar Corporation, Amalgamated Sugar Company, Great Western Sugar Company, and Spreckels Sugar Company.

Item 9. SLC 125 MS mm (F_1 hybrid to SLC 125) - will not be increased through the Foundation but will be shared by Utah-Idaho Sugar Company, Holly Sugar Corporation, Amalgamated Sugar Company, and Spreckels Sugar Company.

1/ Seed listed is that proposed for release and increase through the Beet Sugar Development Foundation, 1957, and discussed at the Boise meeting of the Foundation.

II. U. S. Agricultural Research Station, Salinas, California.

Item 10. C7507 - will be increased by the West Coast Beet Seed Company for Holly Sugar Corporation, American Crystal Sugar Company, Spreckels Sugar Company, and Union Sugar Division. Canadian Sugar Factories, Limited wishes to have a small sample of this seed.

Item 11. C7507HO - will be increased and distributed the same as for Item 10.

Item 12. C7515 - will be increased and distributed the same as for Item 10.

Item 13. C7515HO - will be increased and distributed the same as for Item 10.

Item 14. C7507H1 - will be increased by Union Sugar Division. Before increasing, Holly Sugar Corporation and Spreckels Sugar Company want 50 grams each and Great Western Sugar Company wants 10 grams.

Item 15. C7508 - will be increased. Distribution will be determined during the summer Foundation meeting in 1958.

Item 16. C7508HO - will be increased. Distribution will be determined during the summer Foundation meeting in 1958.

Item 17. C787 - will be increased by West Coast Beet Seed Company as stock seed. Great Western Sugar Company wants 10 grams and Holly Sugar Corporation, 50 grams, as soon as harvested.

III. Breeding for Improvement in Leaf-Spot and Black-Root Resistance.

Item 18. SP 5713-0 - will not be increased through the Foundation but will be shared as follows: Great Western Sugar Company, 2 pounds; Utah-Idaho Sugar Company, 25 grams; Spreckels Sugar Company, 25 grams: Holly Sugar Corporation, 3 pounds; American Crystal Sugar Company, 2 to 5 pounds and Farmers and Manufacturers Beet Sugar Association, the balance.

Item 19. SP 5714-0 - will not be increased through the Foundation but will be distributed the same as Item 18.

Item 20. SP 5716-0 - will not be increased through the Foundation but will be distributed the same as Item 18.

Item 21. SP 571850-00 - will be increased for Great Western Sugar Company and Farmers & Manufacturers Beet Sugar Association. Before increasing, Great Western Sugar Company, Utah-Idaho Sugar Company, Spreckels Sugar Company and Amalgamated Sugar Company would each like 10 grams and Holly Sugar Corporation would like 25 grams.

III. (Continued)

Item 22. SP 5733-0 - will be increased for Farmers and Manufacturers Beet Sugar Association, American Crystal Sugar Company, Holly Sugar Corporation, and Great Western Sugar Company. Before increasing, Great Western Sugar Company, Utah-Idaho Sugar Company, Spreckels Sugar Company, and American Crystal Sugar Company would each like 10 grams and Holly Sugar Corporation would like 25 grams.

* Item 23. SP 5734-0 - will be increased for Great Western Sugar Company, Farmers and Manufacturers Beet Sugar Association, Holly Sugar Corporation, and American Crystal Sugar Company. Before increasing, Great Western Sugar Company, Utah-Idaho Sugar Company, Spreckels Sugar Company, American Crystal Sugar Company and Amalgamated Sugar Company would each like 10 grams and Holly Sugar Corporation would like 25 grams.

IV. Breeding for Leaf-Spot and Curly-Top Resistance.

Item 24. SP 571-0 - will be increased by the Utah-Idaho Sugar Company. Other companies will wait and share in the increase.

Item 25. SP 57102-0 - will be increased by the Utah-Idaho Sugar Company. Other companies will wait and share in the increase.

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* Item 23 - SP 5734-0, Monogerm.
This item was withdrawn from the list of proposals for seed increase through the Beet Sugar Development Foundation, due to small quantity of seed available August 1957. However, SP 5734-0 is being increased on the Plant Industry Station through transplanting greenhouse-grown seedlings.

1957 Seed Production
of 1956 Proposals for
Seed Increase
(See 1956 Report, pp. 6-19)

from Salt Lake City, Utah

SLC 15: Seed increase by Utah-Idaho Sugar Co. 1957 production, 152 lbs.

SLC 18: Seed increase by Utah-Idaho Sugar Co. 1957 production 41 lbs.

SLC 19: Seed increase by Utah-Idaho Sugar Co. 1957 production 165 lbs.

SLC 20: Seed increase by West Coast Beet Seed Co. 1957 production = W.C. 7225.

SLC 22: Seed increase by West Coast Beet Seed Co. 1957 production = W.C. 7226.

SLC 24: Seed increase by Utah-Idaho Sugar Co. 1957 production 141 lbs.

SLC 119: Seed increase by Utah-Idaho Sugar Co. 1957 production 2 lbs.

SLC 121: Seed increase by Utah-Idaho Sugar Co. 1957 production 105 lbs.

SLC 122-0: Seed increase by Utah-Idaho Sugar Co. 1957 production 31 lbs.

from Salinas, California

NB4: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-554.*

681M x NB4: Seed increase by West Coast Beet Seed Co. 1957 production designated F.57-554M2.

668M x NB4: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-554M3.

NB1 x NB4: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-554H1.

NB1 x NB3 x 6554M1: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-72H1.

NB1 x NB2 x 6554M1: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-72H2.

585: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-85.

585HO: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-85HO.

586: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-86.

NB1 x NB4 x 586: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-86H1.

NB1 x NB1: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-502H0.

NB1 x NB3: Seed increase by West Coast Beet Seed Co. 1957 production designated F 57-509H1.

663: F 57-63 for 663, with 3,366 pounds produced. West Coast numbers not available.

* F = Beet Sugar Development Foundation

from Beltsville, Maryland

SP 55206-0: Increase by West Coast Beet Seed Co. 1957 production designated W.C. ?

SP 5517-0: No increase. Withdrawn.

SP 55600-01: Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7324.

SP 5611-0: Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7337.

WC 6200 (from SP 5510-0): Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7370.

WC 6201 (from SP 5512-0): Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7320.

SP 557-0: Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7207.

SP 558-0: Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7208.

SP 566-0: Seed increase by West Coast Beet Seed Co. 1957 production designated W.C. 7209.

SP 554-0: Seed increase by Utah-Idaho Sugar Co. 1957 production, 116 lbs.

SP 555-0: Seed increase by Utah-Idaho Sugar Co. 1957 production, 67 lbs.

SP 5551-0: Seed increase by Utah-Idaho Sugar Co. 1957 production, 108 lbs.

PART II

DEVELOPMENT AND EVALUATION OF INBRED LINES AND HYBRID VARIETIES OF SUGAR BEETS

with emphasis on

Curly Top Resistance
Monogermness and High Quality

Supported under Foundation Projects 22, 23, and 15

F. V. Owen
A. M. Murphy
Charles Price
G. K. Ryser
C. H. Smith
Myron Stout
and
Cooperators

PART II

INTRODUCTION

One of the encouraging things about some of the newer curly-top resistant monogerm lines is their relatively high sucrose content in spite of direct reproduction after selection for high curly-top resistance. The monogerm line SLC 122, which was conspicuous for its high curly-top resistance at Jerome, Idaho in 1957, showed a sugar percentage equal to that of the better sugar type multigerm lines. The root type in SLC 122 was not too desirable but among the twenty sublines tested some were much more acceptable than others. From SLC 122 and related material, new primary selections were made in 1957 with special emphasis on better root type. From 214 highly-selected mother beets, determinations were made for Amino N, sodium, potassium and a respiration coefficient. In addition pulp samples were sent to the American Crystal Sugar Company for galactinol determinations.

In cooperation with the Amalgamated Sugar Company and the Utah-Idaho Sugar Company, hybrid combinations were made with monogerm sublines of SLC 122 in 1957. For this hybridization work SLC 122 progenies were taken which segregated for Mendelian male sterility from which pollen producers were rogued out in the bud stage. The hybrids produced by this method can be included in 1958 field tests for information on combining ability.

The two pages which follow report data, part of which was obtained under project 22 at Jerome and Twin Falls, Idaho, and part under project 23 at Salt Lake City, Utah.

SUBLINES OF THE SELF-FERTILE MONOGERM LINE SLC 122

1957 COMPARISONS

S.L. No.	CODE	JEROME CT GRADE July 30	Aug. 28	Sept. 25	TAYLORSVILLE, UTAH Tons per acre	Percent sucrose	TWIN FALLS, IDAHO Tons per acre	Percent sucrose
6603**	(16)	2	2	4	20.5	14.7	24.8	16.8
6607	(18)	3	3	6	18.2	13.3		
6609**	(19)	3	2	5	32.9	12.7		
6611	(20)	5	4	7	21.5	15.1	22.6	16.2
6613*	(21)	4	3	4	16.9	15.7		
US 33 check		6	7	7.5				
6615*	(22)	4	3	5	24.2	12.8		
6617*	(23)	5	4	5	18.9	15.3		
6619	(24)	6	5	6	19.2	14.7		
6621*	(25)	5	4	5.5	11.5	16.4		
6623*	(26)	5	4	4	18.2	15.7		
6625**	(27)	3	3	4	25.1	12.6		
6627	(28)	5	4	6	17.7	14.2		
6629	(29)	5	5	6	17.1	14.0	26.9	16.3
6631*	(30)	5	3	3	13.2	13.8		
US 33 check		7	8	9				
6633		6	5	6				
6639*		6	5	5				
6640*		5	6	4				
6641		5	5	6				
6642*		4	4	4				
6643		5	5	5 (yellow foliage)				
US 33 check		7	8	8.5				
US 41 (028) check					26.2	13.3	26.4	16.5

* The twelve sublines with the highest curly-top resistance were re-selected again for high curly-top resistance at Jerome, Idaho in 1957.

** Seed of the three most outstanding lines were planted in steckling plots for increase in 1958. The high yielding line 6609 (Code 19) produced a long, rather upstanding beet, quite different from all sister lines. Line 6625 (Code 27) produced the most desirable root type. Line 6615 (Code 22) produced the most luxuriant growth of foliage.

SIB HYBRIDS[1/] OF SELF-FERTILE MONOGERM LINE SLC 122

1957 COMPARISONS

S.L. No.	CODE	JEROME CT GRADE July 30	Aug. 28	Sept. 25	TAYLORSVILLE, UTAH Tons per acre	Percent sucrose	TWIN FALLS, IDAHO Tons per acre	Percent sucrose
US 33 check		7	8	9				
6241	(31)	4	4	5			24.3	16.0
6242*	(32)	3	3	3	20.0	16.3	24.7	16.9
6243*	(33)	3	3	3				
6244	(34)	5	4	5	21.0	16.4	24.6	17.0
6245	(35)	5	4	5	21.6	16.7	24.9	17.4
6246	(36)	4	4	3	19.7	17.1	23.7	18.1
6247*	(37)	4	3	3	18.3	17.2	20.9	17.3
6248	(38)	4	4	5	19.6	17.0	23.3	16.0
US 33 check		7	8	8				
6249*	(39)	4	4	2	18.0	16.2	21.1	16.5
6250*	(40)	4	4	3	19.7	16.6	26.1	16.5
US 41 (028) check		4	4	5	26.2	14.2	31.2	16.4

* The five sib hybrids with the highest curly-top resistance were re-selected again for high curly-top resistance at Jerome, Idaho in 1957.

1/ Sib or sister hybrids were obtained by tagging pollen-sterile aa mm segregates and allowing them to be open pollinated with sister pollen-producing plants.

PROJECT 22, REPORT OF 1957 RESULTS

By Albert M. Murphy

JEROME TEST FIELD FOR CURLY-TOP RESISTANCE, JEROME, IDAHO.

From spring survey work done by the Entomology Research Station, it was evident that a heavy sugar-beet leafhopper migration would occur in the Jerome area. Accordingly the first planting date, which is ordinarily made the latter part of June, was moved up to June 14, and the second planting was made July 1 instead of about July 15, as is usually the case. In spite of this shift to earlier planting dates, the 1957 curly-top exposure was very severe.

The beet leafhopper migration began the first week in June. The population reached its peak, of approximately ten "bugs" per plant, by the first week in July. This high leafhopper concentration in connection with high summer temperatures afforded an ideal environment for the development of curly top, but did put the beets under a severe test,

Fortunately some of the new breeding stocks possessed remarkable resistance and managed to survive the drastic curly-top exposure in relatively good condition. In this respect the monogerm line SLC 122 and a few other lines, including one monogerm family developed by the Amalgamated Sugar Company, made a remarkable demonstration, with a degree of curly-top resistance that surpassed most of the best multigerm lines. One very encouraging thing about SLC 122 was that among some twenty sublines tested, certain numbers were very outstanding.

The 37 inbreds supplied by the Breeders Forum were severely damaged by curly top for the most part. In this connection the inbred FC 55-8035 (Key number 36 in the 1956 test) was again tested. It again proved to be highly resistant compared to other inbreds, indicating that the 1956 test gave a fair evaluation of its high curly-top resistance.

The following page gives curly-top readings on some of the more important breeding material.

VARIETY TEST UNDER CURLY-TOP EXPOSURE
JEROME, IDAHO, 1957

By Albert M. Murphy

Variety No.	C.T.Grade Aug. 1	Sept. 1	Oct. 1	Variety Description
028	6	4	6	US 41
333	6	7	8	US 33 check
F54-4H7	5	6	6	CT9 MS Hyb. X (US 35 aa X Klein E)
5090H3	3	3	4	211H3 X new CT9
6101	3	3	5	do. X (CT5 X Line 244)
6103	4	3	4	do. X CT5
6105	4	4	5	do. X SLC 122 mm
6109	5	4	6	do. X SLC 109 mm
6111	5	4	7	do. X SLC 111 mm
6113	5	4	5	do. X SLC 113 mm
6114	5	4	6	do. X SLC 114 mm
6117	4	3	4	do. X SLC 117 mm
6133	4	4	5	SLC 122 MS mm
6134	4	4	5	SLC 117 MS mm Hyb. X SLC 122 mm
333	7	8	8	US 33 check
6203	5	5	5.5	aa mm X SLC 117 mm Hybrid
6211	6	6	6.5	SLC 117 aa mm X SLC 114 mm
6219	6	4	6	aa mm X SLC 122 mm
6226	6	6	7	SLC 117 aa mm X V.F.S. Group mm
6229	6	6	6	SLC 122 aa mm X do.
6240	6	6	5	SLC 122 mm
333	7	8	9	US 33 check
U-I E/1	5	5	6	91 MS mm X (US 35 aa X CT9)
C6507H3	6	6	7	(NB1 MS X NB3) X 6507 mm
Tasco 2323	5	6	5	CT9 MS X US 35
6932	6	6	7	SLC 91 MS mm X 4n US 35
6937	5	5	5	4n US 35 by Helen Savitsky
028	5	5	6	US 41
333	7	8	8.5	US 33 check
627	4	5	6.5	((US 35 aa X (US 35 aa X Ovana)) X CT8
630	5	5	5.5	do.
636	5	4	6	((US 35 aa X (US 35 aa X Klein E))X CT8

FURTHER STUDIES CONCERNING VARIETAL REACTION OF SUGAR BEETS TO VIRUS #11 UNDER FIELD CONDITIONS

For the virus test three varieties of sugar beets were planted June 17, 1957 each in an area 100 feet long and 8 rows wide, with rows 22 inches apart. On July 17 the plants in the four center rows of each variety were inoculated with curly-top virus strain 11. Inoculations were made by caging one beet leafhopper on each plant.

All the plants of the three varieties under test were exposed to the natural infection through the season. The natural exposure to curly top was so drastic that it almost completely destroyed US 33, a variety of intermediate curly-top resistance. In 1956 US 33 was severely damaged by curly-top but not destroyed. The three varieties in the 1957 test were SL 92Ml, SP 561-0 and SL 6229. SL 92Ml was also included in the 1956 test. SP 561-0 was developed at Beltsville, Maryland from cooperative work at Las Cruces, New Mexico and was known to be high in curly-top resistance. SL 6229 was obtained by crossing two monogerm lines.

The following table shows 1957 results, and the data for 1956 are included for comparison:

Variety	ACRE YIELD IN TONS Not inoculated	Inoculated	Difference
	1957 Test		
SL 92Ml (CT9 MS X US 22/4)	5.20	3.42	1.78
SP 561-0	4.04	2.11	1.83
SL 6229 (aa mm X SLC 122 mm)	2.47	1.16	1.31
	1956 Test[1]		
SL 92Ml (CT9 MS X US 22/4)	15.29	4.75	10.54
F54-4H7 (CT9 MS Hyb. X Klein E. Hyb.)	11.55	3.96	7.59

The results of these tests show that Virus #11 is capable of greatly reducing the yield of curly-top-resistant varieties.

[1] 1956 Report, Sugar Beet Research, pp. 41-43.

VARIETY TEST, TWIN FALLS, IDAHO, 1957
FIELD TESTS I, II, III, IV AND V

By Albert M. Murphy

Owner: J. S. Feldhusen and Son

Soil type: Portneuf silt loam, deep phase, good drainage.

Rotation: 1956, potatoes; 1955, alfalfa; 1954, alfalfa; 1953, mixed grain; 1952, sugar beets; 1951, beans; 1950, sugar beets; 1949, potatoes; 1948, alfalfa.

Preparation for crops: 'In previous years barnyard manure plowed under for some of the crops. First cutting of alfalfa plowed under for potato crops. For 1957 sugar beet crop:

1. Spread four 3-ton loads of barnyard manure per acre.
2. Broadcast 400 pounds mixed fertilizer (16-20-0) per acre.
3. Plowed March 24
4. Harrowed
5. Leveled
6. Applied 80 pounds per acre NH_4 (Ammonia) 33-1/3%
7. Harrowed twice
8. Planted April 17, 1957
9. Harvested October 21, 1957

Irrigations: June 20, 1957 first time Method: Furrow
Sept. 26, 1957 last time

Total irrigations: Eleven

Thinned: May 28-30, 1957 Hoed; June 25, 1957 first time

Record of strip plantings harvested October 16:

Length of rows, 630 feet:	Tons per acre
8 rows, commercial beets, north side of plot	28.6
8 rows, commercial beets, south side of plot	29.7
8 rows, Hybrid F54-4H7	31.3
4 rows, Klein E (SL 4324)	27.2
4 rows, Poly Beta (SL 6306)	26.6

Because of a wet spring, which delayed the movement of a relatively heavy beet leafhopper infestation, very little curly top developed in resistant varieties. However, curly-top infection reached 100 percent in Klein E and Poly Beta.

Experimental design: Two-row plots 52 feet long in 22" rows. Plots cut to 50 feet for harvest. Both rows harvested for yield with one ten-beet sample for analyses taken from each row. There were five tests:

I - 25 hybrids - See page 24.
II- 12 hybrids, 3 replications - See page 25
III - 19 hybrids without replication - Not reported
IV - 40 inbreds without replication See page 26
V - 25 V.F.S. inbreds, 3 replications - See page 27

Thinning test - See page 28.

VARIETY TEST #1, TWIN FALLS, IDAHO, 1957

25 Varieties
6 Replications

VARIETY		ACRE YIELD GROSS SUGAR, LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'
6103	211H3 X CT5	10,862	30.77	17.65	111
6114	do. X SLC 114 mm	10,324	30.15	17.12	114
6101	do. X (CT5 aa X Line 244)	10,314	28.86	17.87	109
5090H3	do. X New CT9	10,244	29.92	17.12	113
6105	do. X SLC 122 mm	10,158	29.09	17.46	107
6111	do. X " 111 mm	10,144	29.13	17.41	106
6113	do. X " 113 mm	9,924	29.12	17.04	95
6109	do. X " 109 mm	9,906	28.58	17.33	112
6117	do. X " 117 mm	9,796	28.61	17.12	106
202H9	CT9 MS Hyb. X (US 35 aa X US 22/4)	10,594	32.24	16.43	104
6932	91 MS mm X 4n US 35	10,454	30.04	17.40	107
F54-4H7	CT9 MS Hyb. X (US 35 [redacted] X Klein E)	10,360	29.40	17.62	110
Tasco 2323	CT9 MS X US 35	10,242	29.43	17.40	107
F54-4H7	(Duplicate entry)	10,140	29.39	17.25	103
U-I E/1	91 MS mm X (US 35 aa X CT9)	9,858	28.26	17.44	112
C6507H3	(NB1 MS X NB3) X 6507 mm	9,510	27.47	17.31	106
028	US 41	9,472	27.65	17.13	108
6219	aa mm X SLC 122 mm	9,814	27.23	18.02	112
6226	117 aa mm X V.F.S. group (mm)	9,760	26.90	18.14	112
6211	do. X SLC 114 mm	9,270	26.01	17.82	97
6203	aa mm X SLC 117 mm hybrid	9,038	25.23	17.91	104
6229	122 aa mm X V.F.S. group (mm)	8,988	24.91	18.04	103
6240	SLC 122 mm	8,916	25.33	17.60	102
6134	117 MS mm Hyb. X SLC 122 mm	9,468	26.07	18.16	110
6133	SLC 122 MS mm	9,108	25.83	17.63	111
General MEAN of all varieties		9,870	28.22	17.49	
S. E. of MEAN		330	1.719	0.143	
Sig. Diff. (19:1)		920	0.69	0.61	
S. E. of MEAN in % of MEAN		3.34	6.09	0.82	

VARIETY TEST #2, TWIN FALLS, IDAHO, 1957

12 Varieties
3 Replications

VARIETY		ACRE YIELD GROSS SUGAR, Lbs.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'
630	[US 35 aa X (US 35 aa X Ovana)] X CT8	11,392	32.7	17.4	103
F54-4H7	CT9 MS Hyb. X (US 35 aa X Klein E)	10,640	31.3	17.0	102
C672H2	(NB1 MS X NB3) X (NB US 35 aa X NB4)	10,058	30.4	16.5	107
636	[US 35 aa X (US 35 aa X Klein E)] X CT8	9,752	27.1	18.0	99
6224	aa mm Sel. X V.F.S. mm group	9,574	27.3	16.9	83
627	[US 35 aa X (US 35 aa X Ovana)] X CT8	9,300	27.1	17.2	108
6932	SLC 91 MS mm X 4n US 35	9,300	27.8	16.7	98
6937	4n US 35 by Helen Savitsky	9,282	27.9	16.7	89
6230	aa mm Sel. X V.F.S. mm group	9,130	27.2	16.8	106
6225	aa mm Sel. X do.	8,776	25.3	17.3	104
6214	aa mm Sel. 202 X SLC 114 mm	8,630	25.6	16.9	83
6216	SLC 122-0 mm	8,452	24.4	17.3	96
028	US 41 check1/	10,504	31.3	16.8	
General MEAN of all varieties		9,524	27.83	17.10	
S. E. of MEAN		420	1.24	0.24	
Sig. Diff (19:1)		1,220	3.62	0.71	
S. E. of MEAN in % of MEAN		4.41	4.46	1.40	

1/ Data for US 41 check taken from three nearby plots not specifically replicated in the test.

VARIETY TEST #4, TWIN FALLS, IDAHO, 1957

Inbred lines without replication
(CT9 and US 41 replicated 3 times)

VARIETY	ACRE YIELD GROSS SUGAR, LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'
MULTIGERM LINES				
028 US 41	12,062	37.0	16.3	117
9090 Old CT9	8,350	25.3	16.5	98
4090 New CT9	9,950	30.9	16.1	98
5090 New CT9 subline	8,634	25.1	17.2	109
69.0 do.	8,922	27.2	16.4	102
68.1 CT8 subline	9,000	25.0	18.0	119
68.3 do.	7,646	21.6	17.7	107
68.7 do.	8,550	25.6	16.7	102
68.11 do.	7,598	24.2	15.7	111
68.14 do.	9,076	27.5	16.5	111
68.17 do.	9,222	29.0	15.9	102
68.18 do.	8,352	24.0	17.4	102
68.21 do.	8,958	26.5	16.9	100
68.22 do.	7,542	21.8	17.3	121
68.29 do.	7,990	23.5	17.0	102
623 CT8 mm X CT8	9,988	28.7	17.4	108
625 do. X do.	9,196	27.7	16.6	110
028 US 41	11,014	35.3	15.6	106
4090 New CT9	9,208	27.9	16.5	93
69.0 New CT9 subline	9,262	27.9	16.6	92
9090 Old CT9	8,482	25.7	16.5	83
5090 New CT9 subline	9,010	26.5	17.0	116
614 F_2 (CT5 X CT8)	9,472	28.7	16.5	101
616 CT5 subline	8,410	25.8	16.3	105
618 do.	8,746	27.5	15.9	77
620 do.	9,424	31.0	15.2	102
028 US 41	8,678	26.4	16.5	98
69.0 New CT9 subline	7,702	23.2	16.6	74
5090 do.	7,516	21.6	17.4	80
4090 New CT9	9,702	29.4	16.5	112
9090 Old CT9	7,598	24.2	15.7	81
MONOGERM LINES				
6410 544.7.38 mm	6,374	20.3	15.7	95
6501 545.4.62 mm	10,208	31.7	16.1	100
6502 545.4.63 mm	8,396	26.4	15.9	81
6509 545.5.83 mm	7,426	23.5	15.8	95
6513 546.7.200 mm	8,164	25.2	16.2	78
6516 546.7.202 mm	6,858	21.7	15.8	65
6603 SLC 122 mm subline	8,332	24.8	16.8	81
6611 do.	7,322	22.6	16.2	92
6629 do.	8,770	26.9	16.3	89

VARIETY TEST #5, TWIN FALLS, IDAHO, 1957

Self-fertile monogerm lines developed by
Dr. V. F. Savitsky

25 Varieties
3 Replications

VARIETY		ACRE YIELD			
CODE	ORIGIN	GROSS SUGAR, LBS.	TONS BEETS	PERCENT SUCROSE	BEETS 100'
171	US 104 X 5889 mm	10,840	35.1	15.5	111
33	US 22 X 803 mm	10,468	30.6	17.1	105
028	US 41 check	10,310	31.8	16.2	105
6302	US 104 X 91 mm	10,528	31.9	16.6	108
127	US 22 X 600 mm	10,222	29.1	17.6	110
85	US 104 X 5889 mm	10,034	31.7	15.8	102
124	US 22 X 600 mm	9,860	29.8	16.5	111
129	US 75 X 600 mm	9,796	28.3	17.3	98
25	US 35 X 175 mm	9,792	28.5	16.9	102
90	US 22 X 805 mm	9,762	30.1	16.2	104
32	US 104 X 801 mm	9,760	31.3	16.6	111
126	US 22 X 600 mm	9,684	28.3	17.1	110
215	US 104 X 5968 mm	9,598	28.5	16.8	105
517	US 35 X 600 mm	9,494	28.6	16.6	89
115	US 104 X 5889 mm	9,318	28.9	16.2	108
165	US 22 X 9524 mm	9,236	27.6	16.7	111
122	US 22 X 600 mm	9,026	26.3	17.2	104
5638	US 22 X 600 mm	9,004	27.0	16.6	107
39	US 104 X 5889 mm	8,932	29.5	15.1	98
54	US 22 X 91 mm	8,896	23.2	16.3	100
333	US 104 X 91 mm	8,762	25.1	17.4	87
342	US 22 X 91 mm	8,706	26.7	16.3	91
172	US 22 X 602 mm	8,650	27.3	15.8	99
321	US 22 X 809 mm	8,382	24.3	17.2	86
1273	US 22 X 600 mm	8,338	23.8	17.5	96
General MEAN of all varieties		9,496	28.6	16.6	
S. E. of MEAN		520	1.25	0.32	
Sig. Diff. (19:1)		1480	3.55	0.90	
S. E. of MEAN in % of MEAN		5.48	4.37	1.93	

MECHANICAL THINNING VERSUS HAND THINNING WITH MULTIGERM AND MONOGERM SUGAR BEETS TWIN FALLS, IDAHO, 1957 *

Mechanical thinning is now being used in conjunction with hand thinning to a greater or lesser extent in all beet growing areas. The ultimate end is to replace hand thinning entirely by machine thinning. Experiments towards this end were conducted at Twin Falls.

The following table records stands at harvest, and yields obtained by using three different methods of reducing initial stands:

SEED PLANTED	TYPE OF THINNING	BEETS PER 100' at HARVEST	ACRE YIELD IN TONS
Monogerm 1/	Hand thinned--short-handled hoe	81	29.11
Multigerm 2/	do. do. do.	94	28.71
	Difference		0.40
Monogerm	Machine, plus long-handled hoe	78	27.47
Multigerm	do. do. do.	93	26.59
	Difference		0.88
Monogerm	Machine only, thinned (twice over)	95	27.99
Multigerm	do. do. do.	136	26.53

1/ Monogerm seed was F54-4H22 = MS mm 23H15 X (US 35 aa X Klein E) Processed 7/64 to 10/64 by the Amalgamated Sugar Company.

2/ The curly-top-resistant multigerm seed furnished by the Amalgamated Sugar Company and processed 7/64 to 10/64 inches.

Good initial stands were obtained. The data indicate that nothing was gained by spending money to supplement the machine thinning job. Time required for the first hoeing, however, was increased.

*Experiment was conducted on J. S. Feldhusen and Son farm. See page 23 for field history.

PROJECT 23, REPORT OF 1957 RESULTS

On the following pages results are tabulated for varietal evaluations at several locations. In these tests a series of hybrids with the multigerm male-sterile number SL 211H3 were extensively replicated. SL 211H3 is roughly equivalent in performance to the variety US 22/3, from which it was derived. All crosses between the new monogerm lines released to the industry, and 211H3, produced good hybrids. This preliminary information should be useful to sugar companies that have increased these monogerm lines for hybridization purposes.

A few selected multigerm lines were also crossed to 211H3 for combining ability information. One combination of special interest was the F_1 hybrid 6101 = 211H3 X (CT5 aa X Line 244). This hybrid was the highest of all the 211H3 hybrids in curly-top resistance at Jerome, Idaho and also highest of all in sugar percentage both at Salt Lake City and Twin Falls, Idaho. Therefore, the use of line 244 in the parentage appears to have been of some advantage. Previous to making the hybrid, considerable information had been accumulated regarding line 244. Its uniformly high curly-top resistance and dark green foliage, made it outstanding at Jerome, Idaho for several years. At Salt Lake City line 244 gave variable results in tests conducted for three years. Without the encouraging results from its performance in hybrid combinations, line 244 would undoubtedly have been discarded.

In the test at Brawley, California, the most striking data were obtained from sublines of the multigerm inbred CT8. Some sublines of this inbred produced yields equal to the better hybrid combinations.

VARIETY TEST, TAYLORSVILLE, UTAH, 1957

By C. H. Smith

Grower: Rell Swensen

Soil type: Welby fine sandy loam

Previous crops: 1952, alfalfa; 1953, grain; 1954, sugar beets; 1955, onions; 1956, sugar beets.

Fertilizers and Cultural Practices: Applications of manure and commercial fertilizers were used in conjunction with previous crop rotation. In 1957 about 15 spreader loads of manure (chicken litter) and 200 pounds of ammoniated phosphate (20-40) per acre, were applied and worked into the soil during seedbed preparation.

Soil Fumigation: The soil was fumigated with Shell DD at 25 gallons per acre April 16, by chisel method.

Planted: May 2

Thinned: June 3

Irrigations: First irrigation May 7. Total of eleven irrigations by furrow.

Harvested: October 15. At harvest the tops were removed with a roto-beater and beets scalped with tractor-mounted scalping tools supplemented by long-handled hoe work. Beets were counted before pulling. Two ten-beet samples were taken from each plot at random for sugar analyses, except tests having twelve replications, in which instances one fifteen-beet sample was taken. Samples for sucrose determinations were weighed after washing in the laboratory to ascertain tare values for each variety.

Experimental Design: The variety tests considered here were all of randomized block design. The beets were planted in 2-row plots with 20 inches between rows. Objective at thinning was 8 to 10 inches but some variations occurred. Four-foot alleys were cut between plots. Effective plot length was 21 feet.

VARIETY TEST #1, TAYLORSVILLE, UTAH, 1957

16 Varieties
6 Replications

VARIETY		ACRE YIELD GROSS SUGAR, LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'
Tasco 2323	CT9 MS X US 35	8,610	31.1	13.84	103
F54-4H7	CT9 MS Hyb. X (US 35 aa X Klein E)	8,244	31.8	12.93	110
202H9	CT9 MS Hyb. X (US 35 aa X US 22/4)	8,172	31.6	12.89	104
C6507H3	(NB1 MS X NB3) X 6507 mm	7,848	29.0	13.51	102
U-I E/1	91 MS mm X (US 35 aa X CT9)	7,486	28.0	13.38	101
5090H3	211H3 X new CT9	8,392	31.3	13.38	100
6101	do. X (CT5 aa X Line 244)	7,734	26.6	14.57	97
6103	do. X CT5	7,774	29.9	12.86	101
6114	do. X SLC 114 mm	7,358	29.1	12.65	101
6109	do. X 109 mm	7,342	27.0	13.58	93
6113	do. X SLC 113 mm	7,200	27.6	12.98	87
6111	do. X " 111 mm	7,148	26.6	13.50	90
6105	do. X " 122 mm	7,100	27.8	12.74	104
6117	do. X " 117 mm	6,948	26.8	12.98	87
6134	117 MS mm Hyb. X SLC 122 mm	6,878	22.9	14.82	96
6133	SLC 122 MS mm	6,800	23.7	14.30	99
General MEAN of all varieties		7,562	28.18	13.43	
S. E. of MEAN		360	1.11	0.36	
Sig. Diff. (19:1)		1040	3.14	1.02	
S. E. of MEAN in % of MEAN		4.76	3.94	2.68	

VARIETY TEST #2, TAYLORSVILLE, UTAH, 1957

8 Varieties
6 Replications

VARIETY		ACRE YIELD GROSS SUGAR, LBS.	TONS BEETS	PERCENT SUCROSE	BEETS 100'
F54-4H7	CT9 MS Hyb. X (US 35 aa X CT9)	7,448	28.6	13.0	109
6203	aa mm X SLC 117 Hyb. mm	6,934	23.7	14.6	102
6226	SLC 117 aa mm X V.F.S. mm group	6,924	24.8	14.0	104
6240	SLC 122 mm	6,826	25.6	13.4	110
6932	SLC 91 MS mm X 4n US 35	6,786	26.9	12.6	102
6211	SLC 117 aa mm X SLC 114	6,654	24.4	13.6	96
6219	aa mm X SLC 122 mm	6,504	23.4	13.9	108
6229	SLC 122 aa mm X V.F.S. mm group	6,244	23.1	13.5	103
General MEAN of all varieties		6,788	25.0	13.6	
S. E of MEAN		252	0.91	0.20	
SIg. Diff. (19:1)		NS	2.62	0.57	
S. E. of MEAN in % of MEAN		3.71	3.64	1.47	

TEST #3

4 Varieties
12 Replications

VARIETY	ACRE YIELD GROSS SUGAR, LBS.	TONS BEETS	PERCENT SUCROSE	BEETS 100'
028 US 41	7,598	27.8	13.68	113
Acc. 1370 1/	7,030	28.9	12.22	103
Acc. 1371	6,738	28.7	11.72	95
Acc. 1372	6,266	25.9	12.14	103
General MEAN of all varieties	6,866	27.81	12.44	
S. E. of MEAN	200	0.72	0.20	
Sig. Diff. (19:1)	580	2.05	0.57	
S. E. of MEAN in % of MEAN	2.91	2.59	1.61	

1/ Acc. numbers 1370 to 1372 have been selected for leaf-spot and curly-top resistance.

VARIETY TEST #4, TAYLORSVILLE, UTAH, 1957

37 Varieties
3 Replications

VARIETY		ACRE YIELD GROSS SUGAR, LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'
F54-4H7	CT9 Hyb. X (US 35 aa X Klein E)	9,166	31.4	14.2	111
6936	610 MS mm X 4n US 35	9,056	29.8	15.2	91
C663H1	3501H1 X 663	8,902	30.3	14.7	96
C6577H2	3511H1 X 6577	8,512	28.3	15.0	109
C672H1	5513HO X 672	8,388	27.4	15.3	104
630	US 35 aa X (US 35 aa X Ovana) X CT8	8,362	28.0	15.0	110
6306	Poly Beta	7,982	25.9	15.4	92
6937	4n US 35 by Helen Savitsky	7,932	29.0	13.7	93
56-408	American Crystal	7,876	26.9	14.6	100
56-409	do. do.	7,762	27.2	14.3	97
6231	117 aa mm Hyb. X mm Group	7,634	22.4	17.0	119
Code 124	Dr. Savitsky mm	7,568	24.4	15.5	112
56-407	American Crystal	7,538	26.1	14.4	94
56-412	do. do.	7,508	25.8	14.5	87
028	US 41	7,468	26.2	14.2	104
6225	aa mm Sel. X V.F.S. mm group	7,360	22.9	16.2	104
6230	aa mm X mm Group	7,316	22.7	16.3	113
C5512H2	NB sel. US 35 aa X 35/2	7,242	27.3	13.3	107
56-416	American Crystal	7,184	23.5	14.8	100
6245	122 aa mm X mm Sibs	7,180	21.6	16.7	110
Code 122	Dr. Savitsky mm	7,170	21.3	16.8	106
C674H1	461HO X US 201 B	6,998	23.7	14.8	105
6224	aa mm sel. X V.F.S. mm group	6,972	24.5	14.6	106
6932	91 MS mm X 4n US 35	6,966	23.1	15.1	95
6244	122 aa mm X mm Sibs	6,830	21.0	16.4	94
Code 5414	Dr. Savitsky mm	6,826	21.3	16.1	94
6214	aa mm 202 X SLC 114 mm	6,812	22.0	15.5	102
6246	122 aa mm X mm Sibs	6,728	19.7	17.1	115
6248	do.	6,686	19.6	17.0	103
6216	" do.	6,678	21.2	15.8	96
55-410	American Crystal	6,144	21.0	14.6	106
Code 129	Dr. Savitsky mm	6,554	21.7	15.1	98
6250	122 aa mm X mm Sibs	6,548	19.7	16.6	101
6242	do.	6,454	20.0	16.3	116
6247	do.	6,274	18.3	17.2	99
6229	122 aa mm X mm group	5,972	18.3	16.4	99
6249	do. X mm Sibs	5,812	18.0	16.2	101
General MEAN of all varieties		7,308	23.83	15.46	
S. E. of MEAN		608	2.35	0.43	
Sig. Diff. (19:1)		1720	6.65	1.22	
S. E. of MEAN in % of MEAN		8.32	9.86	2.78	

VARIETY TEST #5, TAYLORSVILLE, UTAH, 1957

Inbred Line Test

36 Varieties
3 Replications

VARIETY		ACRE YIELD GROSS SUGAR, LBS.	TONS BEETS	PERCENT SUCROSE	BEETS 100'
	MULTIGERM LINES				
028	US 41	6,608	26.2	12.6	107
9090	Old CT9	5,070	17.6	14.4	96
4090	New CT9	5,092	18.4	13.9	91
5090	New CT9 subline	5,564	18.1	15.4	106
69.0	New CT9 subline	5,468	18.9	14.5	88
5070	Line 287 or CT7	5,476	17.7	15.4	116
50.158	CT8	5,924	18.7	15.8	98
68.1	CT8 subline	4,890	16.4	14.9	105
68.3	do.	5,344	17.5	15.3	112
68.7	do.	6,002	20.3	14.8	113
68.11	do.	6,950	23.0	15.1	115
68.14	do.	6,060	21.2	14.3	113
68.17	do.	6.846	23.1	14.8	107
68.18	do.	5,818	19.2	15.2	118
68.21	do.	5,822	18.8	15.5	121
68.22	do.	6,146	20.4	15.0	107
68.29	do.	5,838	19.0	15.4	102
623	CT8 aa X CT8	6,234	21.4	14.5	113
625	do. do.	6,138	20.2	15.3	109
614	F_2 (CT5 X CT8)	5,924	20.2	14.7	100
616	CT5 subline1/	3,080	10.5	14.7	72
618	do.	5,732	20.4	14.1	94
620	CT5 subline1/	4,576	15.8	14.5	90
C5502	Bolting-resistant	4,562	19.6	11.6	94
C5511	do.	4,658	20.0	11.7	63
C5547	do.	4,824	21.3	11.4	87
	MONOGERM LINES				
F55-8	SLC 108 mm	7,390	28.6	12.9	102
6410	544.7.38 mm	4,316	16.9	12.7	91
6502	545.4.63 mm	5,196	21.7	12.0	99
6509	546.5.83 mm	5,286	20.3	13.0	99
6510	546.5.98 mm	5,676	21.2	13.4	87
6513	546.7.200 mm	4,302	14.6	14.8	77
6516	546.7.202 mm	5,850	20.7	14.2	87
6603	SLC 122 mm subline	6,010	20.5	14.7	92
6611	do.	6,534	21.5	15.1	96
6629	do.	4,800	17.1	14.0	99
General MEAN of all varieties		5,672	20.10	14.16	
S. E of MEAN		492	1.73	0.295	
Sig. Diff. (19:1)		1380	4.86	0.834	
S. E. of MEAN in % of MEAN		8.67	8.60	2.08	

1/ Some sublines of CT5 did poorly. The leaves wilted and burned between irrigations. It may have had something to do with nematode injury.

VARIETY TEST #6 TAYLORSVILLE, UTAH, 1957

Self-fertile monogerm lines developed by
Dr. V. F. Savitsky

25 Varieties
3 Replications

VARIETY CODE	VARIETY ORIGIN	ACRE YIELD GROSS SUGAR, LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'
171	US 104 X 5889 mm	7,194	30.5	11.8	95
122	US 22 X 600 mm	6,810	24.0	14.1	94
90	US 22 X 805 mm	6,662	25.0	13.3	98
6302	US 104 X 91 mm	6,582	26.1	12.6	107
32	US 104 X 801 mm	6,424	24.2	13.3	103
028	US 41 check	6,328	25.2	12.6	99
124	US 22 X 600 mm	6,232	23.0	13.5	107
215	US 104 X 5968 mm	6,196	24.5	12.7	97
165	US 22 X 9524 mm	6,064	23.3	13.0	105
25	US 35 X 175 mm	5,998	22.6	13.2	90
115	US 104 X 5899 mm	5,976	23.7	12.6	103
333	US 104 X 91 mm	5,820	20.1	14.5	91
33	US 22 X 803 mm	5,750	21.6	13.3	84
126	US 22 X 600 mm	5,612	20.9	13.5	106
39	US 104 X 5889 mm	5,602	24.0	11.8	98
321	US 22 X 809 mm	5,588	20.8	13.4	94
129	US 75 X 600 mm	5,522	21.3	13.0	82
5638	US 22 X 600 mm	5,362	22.0	12.2	92
172	US 22 X 602 mm	5,332	22.1	12.0	91
127	US 22 X 600 mm	5,312	19.1	13.9	100
85	US 104 X 5889 mm	5,078	21.8	11.5	90
517	US 35 X 600 mm	5,084	20.3	12.5	88
1273	US 22 X 600 mm	5,028	16.9	14.8	95
54	US 22 X 91 mm	5,010	18.7	13.4	75
342	US 22 X 91 mm	4,930	19.9	12.4	82
General MEAN of all varieties		5,820	22.47	12.99	
S. E. of MEAN		510	1.80	0.32	
Sig. Diff. (19:1)		NS	5.12	0.90	
S. E. of MEAN in % of MEAN		8.76	8.01	2.46	

BRAWLEY VARIETY TEST, 1956-57

Planted: September 12, 1956
Harvested: April 24, 1957

By Charles Price and
Terence Donovan

8 replicated plots of each variety

VARIETY	ACRE YIELD GROSS SUGAR	ACRE YIELD TONS BEETS	PERCENT SUCROSE	BEETS 100'	PERCENT BOLTING 3/26/57
6103 (211H3 X CT5)	10,964	35.6	15.4	123	5.3
6109 (211H3 X 109 mm)	10,136	32.7	15.5	112	2.0
6110 (211H3 X 110 mm)	9,454	31.1	15.2*	119	7.2
6111 (211H3 X 111 mm)	10,466	32.3	16.2	103	1.2
6113 (211H3 X 113 mm)	10,112	31.8	15.9*	108	2.9
6114 (211H3 X 114 mm)	10,332	36.9	14.0*	101	10.7
6117 (211H3 X 117 mm)	10,044	31.0	16.2	116	0.9
6211 (117 aa mm X 114 mm)	8,848	28.0	15.8	103	4.2
6931 3n (MS mm X 4n US 35)	10,016	34.3	14.6	91	8.2
6937 4n US 35 by Helen Savitsky	9,456	30.9	15.3	98	9.8
56-204 American Crystal	10,466	34.2	15.3*	112	4.3
MS mm 1/ X 56-204	10,006	32.7	15.3	113	2.2
56-404 American Crystal	7,680	24.0	16.0	117	27.6
MS mm 1/ X 56-404	9,720	30.0	16.2	117	15.9

* Only 7 replications

1/ The MS mm used for hybridization by the American Crystal Sugar Company was: (610 MS mm X 91 mm) MS X SLC 108 mm.

BRAWLEY VARIETY TEST, 1956-57

Planted: September 12, 1956
Harvested: April 24, 1957

By Charles Price and
Terence Donovan

Observation plots without replication

	TWO-ROW PLOTS				SINGLE ROW PLOTS				
VARIETY	TONS PER ACRE	PERCENT SUCROSE	BEETS 100'	PERCENT BOLTING 4/19	LINE No.	TONS PER ACRE	PERCENT SUCROSE	BEETS 100'	PERCENT BOLTING 4/19
					Sublines of CT8				
616 - CT5	**	12.7	56	49.2	68.1	23.9	15.4	124	0
618 - CT5	**	12.7	43	42.0	68.2	28.7	15.4	133	0
620 - CT5	27.4	12.5	72	35.7	68.3	27.5	15.0	135	0
122 mm*	30.3	12.5	55	3.2	68.4	33.5	13.8	109	0
124 mm*	31.9	12.7	72	1.2	68.5	28.8	13.9	64	0
129 mm*	**	12.6	28	0	68.6	21.1	14.6	76	0
5414 mm*	31.1	14.3	86	2.4	68.7	43.7	14.2	116	0
533.4 mm	27.3	13.2	41	2.1	68.8	18.3	14.8	88	0
6404 mm	35.1	11.0	64	54.1	68.9	31.2	15.0	109	0
6409 mm	21.1	13.1	91	13.2	68.10	27.2	15.6	92	3.6
6509 mm	24.0	13.8	89	32.0	68.11	31.9	15.6	117	0
6513 mm	22.0	14.5	98	1.8	68.12	42.0	15.9	91	0
6516 mm	16.1	15.3	104	9.9	68.13	38.7	15.3	88	15.7x
261 mm*	27.2	14.3	92	2.8	68.14	36.4	14.8	138	0
268 mm*	33.1	13.8	121	4.3	68.15	34.5	15.2	124	1.4
3803 mm*	27.3	14.6	123	2.1	68.16	27.3	15.9	147	0
6214 mm	22.3	14.7	97	15.1	68.17	55.0	12.8	107	1.6
6216 mm	14.7	14.4	75	0	68.18	24.3	15.2	109	1.6
6219 mm	20.8	14.7	116	3.7	68.19	23.9	15.8	90	0
6240 mm	28.5	13.2	116	3.7	68.20		14.6	66	0
					68.21	32.9	14.4	140	0
					68.22	30.5	14.8	124	1.4
					68.23	34.8	14.6	136	0
					68.24	32.9	14.2	103	5.0
					68.25	26.2	16.0	138	0
					68.26	26.2	15.8	119	1.4
					68.27	22.4	15.7	131	0
					68.28	22.7	15.6	107	1.6
					68.29	33.6	15.1	143	0
					68.30	22.0	16.2	112	1.5

* Monogerm lines developed by Dr. V. F. Savitsky.

** Yield record not taken because of poor stands.

BEET SUGAR DEVELOPMENT FOUNDATION

PROJECT 15 REPORT

By Myron Stout

LEAF RESPIRATION STUDIES

Considerable work was done on leaf respiration measurements in 1957. Temperature studies of leaf discs in Warburg respirometers showed that temperature affects leaf respiration probably more than it does whole sugar beet roots or thin slices of root tissue. The temperature versus respiration rate curve was also logarithmic in character but has a steeper slope than was obtained on root tissues. The average Q_{10} was approximately 2.57 between 10° and 35°C.

On a fresh weight basis leaf blades respire about fifty times as rapidly as normal-sized whole sugar-beet roots. On a dry weight basis the difference is not so great due to the greater moisture percentage of the leaves. The relative respiration rates of root and leaf tissues can be seen in the following table:

Table 1 -- Respiration rates of whole beet roots, pieces or slices of root tissue and leaf blades at 20°C.

Kind and size of tissue	Respiration rate Oxygen per Kg. per hour	
	Dry wt. basis	Fresh wt. basis
	mg.	mg.
Root, whole beets ave. 2 lbs. each	69	13.8
" 10 gram pieces	250	50.
" 1 mm. slices	400	80.
Leaves (blades only)	3500	455.

Gibberellic acid has little or no effect on the respiration rate of sugar beet leaf discs either when run in a solution of the substance, or following applications as a 500 PPM spray to the leaves of growing plants.

Studies being conducted at the University of Utah by Dr. John D. Spikes have shown a surprisingly high respiration rate in relation to photosynthetic

rate for whole sugar beet plants. The light saturation point for sugar beets is also relatively high, indicating the plants can utilize high intensity illumination before the rate begins to level off as the light intensity is increased. This is very probably a basic reason for the relatively high photosynthetic efficiency of the plant.

Leaf respiration rates of a large number of lines of beets were determined during the fall of 1957. No consistent interpretation of the data has thus far been made.

Individual Root Selections

Individual root selections were made on two curly-top-resistant monogerm varieties in 1957. These two varieties were SL 6240 and SL 6229. The beets were grown at Twin Falls, Idaho, and a very discriminating selection was made in the field for root size and type. Analysis and respiration rate measurements were made on approximately 107 beets of each variety. Variation in all measurements was high in both varieties, making it possible to select some very outstanding individuals for breeding purposes. Since both varieties are self-fertile, small lots of selfed seed should be available from these superior individuals for testing on a small scale in 1958.

Further evaluation of previous selections was limited to yield and sucrose percentage in 1957 due to the fact that tests were conducted on nematode-infested soil.

A very convenient laboratory was constructed in the basement of the main office to run individual root analysis at the same time the sugar laboratory was being used for agronomic testing. For the first time in several years, it was not needed because of the reduced work done in the regular sugar laboratory. Facilities are now available, however, to carry on a full schedule of work in both laboratories.

PART III

DEVELOPMENT AND EVALUATION
of
INBRED LINES AND HYBRID VARIETIES OF SUGAR BEETS
SUITABLE FOR CALIFORNIA

Supported under Foundation Projects 24 and 29

J. S. McFarlane   Charles Price
I. O. Skoyen   T. J. Donovan

Cooperators Conducting Tests:

Union Sugar Division
Holly Sugar Company
Spreckels Sugar Company
Agronomy Department,
University of California

REPORT ON FOUNDATION PROJECT 24

Summary of Accomplishments

J. S. McFarlane

During 1957 major emphasis was placed on the incorporation of the monogerm character into breeding stocks which are resistant to bolting and curly top. Selections were made from a one-half acre planting of S_1 progenies from backcrosses of bolting-resistant monogerms to highly curly-top resistant multigerm material. Relatively poor bolting occurred in the selection plots at Salinas in 1957 so it was necessary to select plants which did not bolt, induce the roots in the cold room, and produce seed in the greenhouse. Good success was obtained with seed production during the short days of December and January.

Additional crosses were made between our more promising monogerm lines and lines from the Salt Lake City program such as SLC 122. Selections will be made from these crosses for non-bolting, curly top resistance, and high sugar.

Type O selection work was continued with both monogerm and multigerm material. An additional bolting-resistant selection was made from C671 which is a composite of all the non-bolting, curly-top-resistant, Type O selections which have been made at Salinas during the past eight years.

Work was continued on the tetraploid and inheritance study projects. Several tetraploids (identified by leaf shape and pollen size) from inbred lines are being increased and will be checked cytologically. F_2 seed from crosses between genotypes of different bolting tendencies were planted in November 1957 for bolting inheritance studies.

Eight new breeder's strains and elite seed stocks were released through the Foundation in 1957. Included were two bolting-resistant monogerm inbreds and their male sterile equivalents. A mildew-resistant

inbred, 7508, which also possesses good curly top and bolting resistance was released. An elite seed lot of a new bolting selection from US 75 was made available for use in producing stock seed.

Evaluation and combining ability tests which were made at several locations in cooperation with the sugar companies and the University of California are summarized in this report. The new hybrids 663H1 and 663H2 performed very well in these tests. The pollen parent in both of these hybrids was a non-bolting, curly top selection from US 15 x US 22/3. The hybrid, 663H1, which has the parentage (MS of NB1 x NB3) x 663 possesses excellent curly top resistance and moderate bolting resistance. It performed well in all tests and especially well in the Imperial Valley tests. The hybrid, 663H2, which has the parentage (4547HO x NB1) x 663 has good curly top resistance and excellent bolting resistance. It performed especially well in the coastal area. Tests with hybrids involving the 6507 monogerm inbred showed that it had good combining ability for both yield and sugar.

Bolting Tests with Non-bolting Varieties and Inbreds

Several bolting-resistant varieties and inbreds were planted in nurseries at Salem, Oregon; Tehachapi, California; Medford, Oregon; Tracy, California; Salinas, California; Phoenix, Arizona; Las Cruces, New Mexico; and Albuquerque, New Mexico in the fall of 1956. These plantings were made by the West Coast Beet Seed Company, Farrar-Loomis Seed Company, Western Seed Production Corporation, Holly Sugar Corporation, and the U. S. Department of Agriculture. Bolting counts were made in the spring of 1957. Bolting percentages which were computed from these counts are shown in table 1.

The most complete bolting was obtained at Medford, Oregon. The percent bolting was similar at Salem and Tehachapi. The results at both Salem and Tehachapi served to emphasize the necessity of planting bolting-resistant inbreds by early August if complete participation in seed production is to be obtained. Bolting was poor in all lots at Phoenix. The more bolting-resistant inbreds failed to produce any seedstalks in this environment. At Las Cruces and Albuquerque the varieties US56/2 and US75 bolted between 85 and 95 percent but the inbreds bolted poorly. The counts at Albuquerque were made on May 18 before bolting was complete. Mr. Mast predicted that the inbreds would bolt later in the season but was unable to make a later count.

The season 1956-57 was unfavorable for the induction of bolting at both Salinas and Tracy. The varieties US56/2 and US75 bolted very poorly and several of the inbreds failed to produce any seedstalks. A portion of the Salinas nursery measuring 90 by 70 feet was lighted from January 4 to June 12. Light intensity varied from five candlepower in the poorest lighted portion of the plot to 45 candlepower in the best lighted portion. Light was furnished for six hours each night from 10:00 p.m. to 4:00 a.m. An improvement in bolting was obtained in most varieties and inbreds. There was insufficient thermal induction to cause complete bolting in any of the bolting-resistant varieties or inbreds even with the additional photo induction. Certain lines, especially the inbred 5513, showed a marked response to the longer photo period. This inbred bolted only 8 percent without light as compared with 89 percent with light.

The results of these tests show that even our most extremely bolting-resistant inbreds can be made to reproduce in Oregon and at Tehachapi provided they are planted early. One of the best examples is inbred 5512 which rarely produces any seedstalks in September plantings at Salinas, and yet bolted 100 percent in a July 23 planting at Medford. It should be possible to develop hybrid varieties which are more bolting resistant than our present commercial varieties and reproduce these hybrids in Oregon and Tehachapi.

Table 1. Percent bolting in sugar beet varieties and inbreds when grown at various locations.[1]

Variety or Inbred	Salem 7/27/56 planting	Salem 8/28/56 planting	Tehachapi 7/30/56 planting	Tehachapi 8/15/56 planting	Medford 7/23/56 planting	Tracy 9/24/56 planting	Salinas[2] 9/12/56 planting No Lights	Salinas[2] 9/12/56 planting Lights	Phoenix 8/31/56 planting	LasCruces 8/25/56 planting	Albuquerque[3] 8/27/56 planting
US75	100	100	98	98	-	15	6	-	32	95	85
US35/2	100	100	100	-	-	37	10	68	38	90	95
581	100	100	93	96	100	-	0	-	22	95	90
585	100	-	-	-	-	3	0	34	-	-	-
5509H1	100	88	98	92	100	10	26	31	44	85	15
5511H1	100	94	100	96	100	47	16	-	24	95	15
5512H1	98	93	92	92	-	5	0	-	4	-	-
5554H1	90	50	98	76	100	7	0	-	2	-	-
NB1	94	-	96	76	100	0	0	4	0	70	5
MS of NB1	100	74	93	-	100	0	2	18	0	15	5
NB3	100	-	100[4]	100[4]	100	10	-	63	-	-	-
5512	90	66	76[4]	92[4]	100	0	0	0	-	-	-
5547	100	100	96	72	100	12	0	16	0	5	35
5547HO	100	96	100	-	100	14	0	24	0	40	35
5554	38	24	86	54	-	12	0	0	-	-	-
5503-5	100	80	92	96	100	-	0	4	-	-	-
5513	100	52	-	76	93	14	8	89	-	-	-

1 Bolting data obtained from nurseries which were supervised by the following persons:
Salem, Oregon - S. C. Campbell
Tehachapi, California - Hillas Cole
Medford, Oregon - J. S. McFarlane
Tracy, California - D. D. Dickenson
Salinas, California - J. S. McFarlane
Phoenix, Arizona - A. A. Mast
Las Cruces, New Mexico - A. A. Mast
Albuquerque, New Mexico - A. A. Mast

2 A portion of the Salinas nursery was lighted for six hours each night from January 4 to June 12.

3 Bolting was not complete at Albuquerque on May 18 when the last count was made. Mr. Mast predicted that all lots would bolt later in the season.

4 Seedstalks were just beginning to develop in inbred No. 5512 when counts were made at Tehachapi on May 31 and it is probable that it bolted close to 100 percent in both dates of planting a little later in the season.

VARIETY TEST, SALINAS, CALIFORNIA, 1957

Location: Spence Field of the U. S. Agricultural Research Station.

Soil type: Sandy loam.

Previous crops: Barley green manure 1955 and 1956; beets 1954.

Fertilizer used: 400 lbs. per acre (16-20) preplant.
250 lbs. per acre ammonium sulfate March 8, 1957.
200 lbs. per acre ammonium sulfate April 26, 1957.
250 lbs. per acre ammonium sulfate May 27, 1957.

Planting date: December 17, 1957.

Thinning date: March 2-6, 1957.

Harvest date: August 20-23, 1957.

Irrigations: At 10-day intervals.

Experimental design: Randomized block with 5 replications. Varieties planted in 4-row plots with rows spaced 28 inches apart. Plots 50 feet long. Two rows of each plot were inoculated with virus yellows and the entire test was sprayed at 10- to 14-day intervals to control aphids. Inoculated and non-inoculated plots were harvested separately. Results with the non-inoculated plots are shown in table on following page.

Sugar analyses: From two 10-beet samples per plot by Spreckels Sugar Company.

VARIETY TEST, SALINAS, CALIFORNIA, 1957

(5 replicated plots of each variety)

Planted December 17, 1956
Harvested August 20-23, 1957

Variety	Description	Acre yield Sugar Pounds	Acre yield Beets Tons	Sucrose Percent	Bolting Percent	Harvest count Number
563H2	(4547HO x NB1) x 663	11,891	35.9	16.6	0.1	165
6577H1	5570-49-11H1 x 6577	11,759	34.1	17.2	1.4	142
616	Price's virus yel. sel. US75	11,693	36.8	16.0	1.8	151
5554H1	MS of NB1 x NB4	10,961	34.1	16.1	0.8	152
663	NB, CT sel. (US15 x US22/3)	10,310	32.3	15.9	0	158
672H1	5513HO x (US35/2aa x NB4)	10,280	32.0	16.1	0.8	161
515	Price's virus yel. sel. US75	10,245	32.9	15.6	2.2	159
368	US75	10,222	31.9	16.1	0.1	164
6554H1	5513HO x NB4	10,184	33.4	15.3	0.1	158
511	Greenhouse virus yel. sel. US75	10,028	31.1	16.1	0.1	164
459	US56/2	9,781	30.4	16.1	0.7	167
674H1	461HO x Bolt. res. sel. US201B	9,763	30.1	15.9	12.9	168
General MEAN of all varieties		10,593	32.9	16.1		Beets per 100' row
S. E. of MEAN		461	1.08	0.23		
Significant Difference (19:1)		1,317	NS	0.66		
S. E. of MEAN in % of MEAN		4.35	3.28	1.43		

Odds 19:1 = $2.02\sqrt{2}$ x Standard Error of Mean

VARIANCE TABLE

Variation due to	Degrees of freedom	MEAN SQUARES: Tons gross sugar	MEAN SQUARES: Tons beets	MEAN SQUARES: Percent sucrose
Between varieties	11	3,027,625	9.36	1.14
Between replications	4	3,480,833	38.15	0.91
Remainder (Error)	44	1,062,276	5.88	0.26
Total	59			
Calculated F values		2.85**	1.59(NS)	4.38**

**Exceeds the 1% point of significance (F = 2.68)

..RIETY TEST, BRAWLEY, CALIFORNIA 1956-1957

By Charles Price and T. J. Donovan

Location: S..thwestern Irrigation Field Station.

Previous cro..s: 1954 flax; 1955 cotton; 1956 sugar beets.

F..rtilizer and cultural practices: The field was chiseled prior to planting and the beets were planted on single rows 30 inches apart. After the thinning operation 400 pounds per acre of 16-20-0 fertilizer was applied as a side dressing, and on November 15, 1956, an additional 400 pounds of ammonium nitrate was also applied as a side dressing. Both applications were given just prior to an irrigation. Irrigation needs were determined by the appearance of the beets and by means of soil tensiometers placed in the field. A total of 12 irrigations were given the beets during the growing season.

Planted: September 9, 1956.

Harvested: April 22-27, 1957.

Insects and their control: Army worm and cabbage looper were successfully controlled as needed with applications of Toxaphene and DDT. Crickets were controlled with poison bran. Curly top was of minor importance although a few plants were observed with mild symptoms of the disease. The repeated dusting and spraying for control of other insect pests was probably responsible for keeping the beet leafhoppers controlled and, consequently, curly top was not severe. Virus yellows was observed for the first time in the Imperial Valley. This disease came into the experimental plots late in the growing season, and it is therefore doubtful that reduction in tonnage resulted. The sucrose content of the beets may have been lowered somewhat, but the plots were harvested in April and the sucrose of these beets was relatively higher than in beets harvested later in the season.

E..erimental design: Randomized block with 8 replications. Varieties were planted on single-row beds spaced 30 inches apart. Plots consisted of two rows, 50 feet long. Entire plots were harvested for yield data.

Sugar analyses: From two ten-beet samples per plot by the Holly Sugar Corporation at their Carlton plant.

VARIETY TEST, BRAWLEY, CALIFORNIA, 1957

(8 replicated plots of each variety)

Planted Sept. 9, 1956
Harvested April 22-23, 1957

Variety	Description	Acre Yield			Beet count
		Sugar	Beets	Sucrose	count
		Pounds	Tons	Percent	Number
663H1	(MS of NB1 x NB3) x 663	10,170	30.23	16.83	139
5554H1	MS of NB1 x NB4	10,046	30.41	16.53	139
6507H3	(MS of NB1 x NB3) x 6507	9,863	29.40	16.81	126
5509H2	MS of NB1 x NB3	9,796	29.58	16.59	135
672H2	(MS of NB1 x NB3) x (US35/2aa x NB4)	9,718	29.21	16.65	140
663H2	(4547H0 x NB1) x 663	9,665	28.64	16.88	136
663	NB, CT sel. US15 x US22/3	9,342	28.52	16.39	139
581H1	(MS of NB1 x NB3) x NB,CT Sel.US35/2	9,043	26.79	16.88	139
466H1	(MS of NB1 x NB2) x NB sel. US35/2	8,958	26.57	16.85	136
6577H2	(MS of NB1 x NB2) x 6577 inbred	8,930	26.59	16.78	131
F56-79	Price's sel. from US75	8,483	25.57	16.61	143
368	US75	8,381	25.39	16.51	136
674H2	(MS of NB1 x NB3) x US201B	8,343	25.38	16.44	134
672H1	5513H0 x (US35/2aa x NB4)	8,134	24.55	16.56	141
459	US56/2	8,133	24.09	16.86	131
674H1	461H0 x US201B	7,456	22.14	16.85	134
General MEAN of all varieties		9,029	27.07	16.69	
S. E. of MEAN		329.5	0.58	0.16	Per
Significant difference (19:1)		923	1.62	NS	100
S. E. of MEAN in % of MEAN		3.65	2.14	0.96	row

(Odds 19:1 = 1.98 $\sqrt{2 \text{ x}}$ Standard Error of Mean)

VARIANCE TABLE

Variation due to	Degrees of freedom	MEAN SQUARES Pounds sugar	Tons beets	Percent sucrose
Between varieties	15	5,268,357	47.96	0.23
Between replications	7	1,052,878	11.31	1.41
Remainder (Error)	105	868,367	2.69	0.20
Total	127			
Calculated F value		6.07**	17.83**	1.15(NS)

** Exceeds the 1% point of significance (F = 2.82)

VARIETY TEST, DAVIS, CALIFORNIA, 1957

R. S. Loomis

Location:	Campbell Tract of the Agronomy Department, University of California at Davis.
Soil Type:	Yolo loam.
Previous crops:	1956 - fallow; 1955 - fallow; 1954 - barley and flax; 1953 - levelled.
Fertilizer used:	April 26, 218 lbs. NH_4NO_3 per acre, sidedressed May 29, 240 " " " " " " 458 " total, equivalent to 153 lbs. N per acre.
Planting date:	March 25
Thinning date:	April 29 (8 inch centers)
Harvest date:	October 21
Irrigations:	March 29-31, May 8, June 5, and every 10 days thereafter until the terminal irrigation on August 23.
Experimental design:	Randomized complete block with 8 replications. Varieties planted in two-row (one bed on a 14-26" spacing) plot 60 feet long. Fifty feet of both rows harvested.

General notes:

Variety C5509H1 gave poor stands and after thinning on April 29 it was noted that plots of this variety in five of the eight replications had spotty stands and lacked vigor. Only a few serious gaps were present and no attempt was made to adjust yields for stand distribution.

A severe infestation by serpentine leaf miner during late May and early June was controlled by the application of 12 oz. (actual) emulsifiable dieldrin per acre on June 11. The field had a history of root knot nematode and 20 gallons of diethyl dibromide fumigant per acre were applied in November, 1956. No evidence of root knot or sugar beet nematodes was apparent at harvest time.

Virus yellows was apparent in all varieties except C5509H1 by mid-June. By mid-August, yellows could also be diagnosed in C5509H1 but the yellowing was largely confined to the leaf margins.

Sugar analyses: From fresh samples by Spreckels Sugar Company at Woodland, California.

Table 1

VARIETY TEST, DAVIS, CALIFORNIA, 1957

(8 replicated plots of each variety)

Planted March 25, 1957
Harvested October 21, 1957

Variety	Description	Acre yield Sugar Pounds	Acre yield Beets Tons	Sucrose Percent	Harvest count Number
5509H1	MS of NB1 x NB3	7,380	32.5	11.4	143
SL6305	(SL610 x SL91) MSmm x (US35aa x CT9)	7,110	31.5	11.3	154
6507H1	4516HOmm x 6507mm	7,000	29.3	12.0	152
368	US 75	6,800	30.0	11.3	150
673H1	461HO x 53AB1-65	6,020	26.3	11.2	147
6516H1	5515HOmm x 6516mm	5,360	23.2	11.4	150
General MEAN of all varieties		6,610	28.8	11.4	Beets
S. E. of MEAN		191 1/	0.73	0.16	per
Significant Difference (19:1)		548	2.10	0.46	100'
S. E. of MEAN in % of MEAN		2.90	2.53	1.40	

Odds 19:1 = $2.03\sqrt{2}$ x Standard Error of Mean

1/ By short-cut formula

VARIANCE TABLE

Variation due to	Degrees of freedom	MEAN SQUARES Cwt. gross sugar	Tons beets	Percent sucrose
Between varieties	5	470.11	97.58	0.66
Between replications	7	37.02	2.01	0.38
Remainder (Error)	35	32.66	4.25	0.21
Total	47			
Calculated F values		14.39**	22.96**	3.20*

* Exceeds the 5% point of significance (F = 2.49)
**Exceeds the 1% point of significance (F = 3.60)

VARIETY TEST, DAVIS, CALIFORNIA, 1957

Table II

Observations

Variety	Vigor[1/] May 13	Vigor June 19	Vigor July 31	Vigor Average	Color[2/] June 19	Color July 31	Color Average
C 368	3.0	3.0	3.0	3.0	1.0	1.9	1.4
C 673H1	1.6	1.4	1.9	1.6	2.1	2.2	2.2
C 6507H1	2.4	1.3	1.4	1.6	1.9	2.9	2.4
C 6516H1	3.2	2.6	2.6	2.8	3.0	3.0	3.0
SL 6305	1.9	1.6	2.2	1.9	1.3	1.9	1.7
C 5509H1	2.9	2.8	3.3	3.0	1.0	1.0	1.0

[1/] Vigor estimated from top development on a scale of 1 → 5 (1 = most vigorous) relative to C 368 = 3.0. Averages of eight replications.

[2/] Color estimated on a scale of 1-3 (1 = dark green; 3= light green). Averages of eight replications. Readings reflect natural color of foliation and virus yellows infestation

TABLE III

NO_3-N Content of Leaf Petioles. Reported in Parts Per Million (Dry Basis)

May 25	June 19	July 12	July 31[1/]	September 4[1/]	October 5[1/]
17,370	12,210	11,270	6,670	6,610	[2/]

[1/] On the last three sampling dates, varieties were sampled individually. C 6516H1 gave slightly higher values than the mean but no other differences were apparent.

[2/] Analyses not yet complete.

VARIETY TEST, KING CITY, CALIFORNIA, 1957

By Union Sugar Division

Location: A. S. Duarte Farm at King City, California.

Soil type: Clay loam.

Previous crops: Beans, 1954; tomatoes, 1955; barley, 1956.

Fertilizer used: 300 lbs. per acre (16:10) preplant.
300 lbs. per acre ammonium sulfate.
400 lbs. per acre ammonium sulfate.

Planting date: March 20, 1957.

Thinning date: April 30, 1957.

Harvest date: October 25, 1957.

Irrigations: Six.

Experimental design: Randomized block with six replications. Varieties planted on double-row beds with 40-inch centers. Plots 60 feet long.

Diseases and insects: Severe leaf miner infestations occurred in late summer which resulted in extensive killing of foliage. Considerable regrowth had occurred by late October. Diseases were of minor importance in this test.

Sugar analyses: From two ten-beet samples per plot by Union Sugar Division, Betteravia, California.

Remarks: Seed was furnished, test designed, and results analyzed by J. S. McFarlane and I. O. Skoyen. The average yield for the 50-acre field in which this test was located was 38 tons per acre.

VARIETY TEST, KING CITY, CALIFORNIA, 1957

(6 replicated plots of each variety) By Union Sugar Division

Variety	Description	Acre yield Sugar Pounds	Acre yield Beets Tons	Sucrose Percent	Harvest count Number
663H2	(4547HO x 5510) x 663	15,547	47.4	16.4	181
663H1	(MS of NB1 x NB3) x 663	15,315	47.3	16.2	179
663	Bolt., CT sel. (US15 x US22/3)	14,577	46.1	15.8	180
6507H3	(MS of NB1 x NB3) x 6507mm	14,305	44.2	16.2	189
581H1	(MS of NB1 x NB3) x 581	14,034	43.1	16.3	178
6554H1	5513HO x NB4	13,875	44.5	15.6	183
6577H2	(MS of NB1 x NB2) x 6577	13,697	41.8	16.4	187
F56-66H2	(MS of NB1 x NB2) x 366	13,619	41.5	16.4	168
368	US 75	13,388	42.9	15.6	166
5547H1	(MS of NB1 x NB3) x 5547	13,383	42.6	15.7	173
459	US 56/2	13,222	40.8	16.2	170
672H1	5513HO x (266aa x NB4)	12,889	39.8	16.2	194
General MEAN of all varieties		13,988	43.5	16.1	Beets
S. E. of MEAN		406[1]	1.16	0.18	per
Significant Difference (19:1)		1,147	3.29	0.52	100'
S. E. of MEAN in % of MEAN		2.90	2.67	1.13	row

(Odds 19:1 = $2\sqrt{2}$ x Standard Error of Mean)

[1] By short cut formula.

VARIANCE TABLE

Variation due to	Degrees of freedom	MEAN SQUARES Tons beets	MEAN SQUARES Percent sucrose
Between varieties	11	36.56	0.64
Between replicates	5	6.68	1.03
Remainder (Error)	55	8.10	0.20
Total	71		
Calculated F values		4.51**	3.20**

**Exceeds the 1% point of significance (F = 2.59)

VARIETY TEST, SAN ARDO, CALIFORNIA, 1957

By Union Sugar Division

Location: Frank Taylor Ranch, San Ardo, California.

Soil type: Sandy loam.

Previous crops: Sugar beets, 1954; carrots, 1955 and 1956.

Fertilizer used: 400 lbs. per acre (16:20) preplant
300 lbs. per acre ammonium sulfate
300 lbs. per acre ammonium sulfate

Planting date: March 20, 1957.

Thinning date: April 30, 1957.

Harvest date: October 31, 1957.

Irrigations: Seven.

Experimental design: Randomized block with six replications. Varieties planted on double-row beds with 40-inch centers. Plots 60 feet long, but only 12 feet harvested from each 2-row plot because of spotty stand.

Diseases and insects: Replication six was not harvested because of severe nematode damage. Replications one through five showed little evidence of nematode injury. Other disease and insect damage was of minor importance in this test.

Sugar analyses: From one 15-beet sample per plot by Union Sugar Division, Betteravia, California.

Remarks: Seed was furnished, test designed, and results analyzed by J. S. McFarlane and I. O. Skoyen.

VARIETY TEST, SAN ARDO, CALIFORNIA 1957

(5 replicated plots of each variety) By Union Sugar Division

Variety	Description	Acre yield Sugar Pounds	Acre yield Beets Tons	Sucrose Percent	Harvest count Number
663H2	(4547HO x 5510) x 663	9,682	37.0	13.1	149
663	Bolt., CT sel. (US15 x US22/3)	9,486	37.7	12.6	164
663H1	(MS of NB1 x NB3) x 663	9,330	36.6	12.7	162
672H1	5513HO x (266aa x NB4)	9,240	33.8	13.7	163
581H1	(MS of NB1 x NB3) x 581	9,152	34.5	13.3	168
672H2	(MS of NB1 x NB3) x (266aa x NB4)	8,948	33.1	13.5	146
6577H2	(MS of NB1 x NB2) x 6577	8,776	34.7	12.7	163
F56-66H2	(MS of NB1 x NB2) x 366	8,746	33.4	13.1	158
6554H1	5513HO x NB4	8,464	33.4	12.7	143
459	US56/2	8,290	31.7	13.1	158
368	US75	8,278	34.9	11.9	157
5547H1	(MS of NB1 x NB3) x 5547	7,538	31.6	11.9	157
General MEAN of all varieties		8,828	34.4	12.9	Beets per 100' row
S. E. of MEAN		376 1/	1.25	0.28	
Significant Difference (19:1)		1,063	3.54	0.80	
S. E. of MEAN in % of MEAN		4.26	3.63	2.17	

Odds 19:1 = $2\sqrt{2}$ x Standard Error of Mean

1/ By short-cut formula

VARIANCE TABLE

Variation due to	Degrees of freedom	MEAN SQUARES Tons beets	MEAN SQUARES Percent sucrose
Between varieties	11	18.94	1.55
Between replications	4	58.98	14.59
Remainder (Error)	44	7.83	0.40
Total	59		
Calculated F values		2.42*	3.75**

* Exceeds the 5% point of significance (F = 2.01)
**Exceeds the 1% point of significance (F = 2.68)

VARIETY TEST, BETTERAVIA, CALIFORNIA, 1957

By Union Sugar Division

Location: Union Sugar Ranch, Santa Maria, California.

Soil type: Yolo sandy loam.

Previous crops: Beans, 1954; beans, 1955; potatoes, 1956.

Fertilizer used: 100 units NH_3.
150 units NH_3 and Shell ammonia.

Planting date: January 10, 1957.

Thinning date: February 25, 1957 (skips replanted March 21, 1957.)

Harvest date: November 7, 1957.

Irrigations: 3

Experimental design: Randomized block with 7 replications. Varieties planted on double-row beds with 40-inch centers. Plots were 40 feet long.

Diseases and insects: None.

Sugar analyses: From two 10-beet samples per plot by Union Sugar at Betteravia, California.

Remarks: Seed furnished, test designed, and results analyzed by J. S. McFarlane and I. O. Skoyen. Irregular stands and livestock damage contributed to the variability in the results.

VARIETY TEST, BETTERAVIA, CALIFORNIA, 1957

(7 replicated plots of each variety)

By Union Sugar Division

Variety	Description	Acre yield Sugar Pounds	Acre yield Beets Tons	Sucrose Percent	Bolting Percent	Harvest count Number
663H2	(4547HO x 5510) x 663	8,934	29.8	15.0	0.6	145
672H1	5513HO x (266aa x NB4)	8,354	28.6	14.6	1.7	152
672H2	(MS of NB1 x NB3) x(266aa x NB4)	8,160	26.9	15.2	0.3	139
6507H3	(MS of NB1 x NB3) x 6507	8,014	28.0	14.3	7.2	133
663H1	(MS of NB1 x NB3) x 663	7,856	28.1	14.0	0.8	127
F56-66H2	(MS of NB1 x NB2) x 366	7,848	27.8	14.1	2.6	126
663	Bolt., CT sel. (US15 x US22/3)	7,484	26.1	14.3	0.4	135
581H1	(MS of NB1 x NB3) x 581	7,476	25.5	14.7	3.2	123
6577H2	(MS of NB1 x NB2) x 6577	7,389	26.0	14.2	16.7	124
5547H1	(MS of NB1 x NB3) x 5547	7,074	26.3	13.4	0.7	133
368	US75	7,008	25.6	13.7	0.7	137
459	US56/2	5,680	20.5	13.9	2.8	112
General MEAN of all varieties		7,606	26.6	14.3	3.14	Beets
S. E. of MEAN		476[1]	1.54	0.33		per
Significant Difference (19:1)		1,346	4.36	0.94		100'
S. E. of MEAN in % of MEAN		6.26	5.79	2.31		row

Odds 19:1 = $2\sqrt{2}$ x Standard Error of Mean

[1] By short-cut formula.

VARIANCE TABLE

Variation due to	Degrees of freedom	MEAN SQUARES Tons beets	MEAN SQUARES Percent sucrose
Between varieties	11	38.68	1.84
Between replications	6	172.62	1.19
Remainder (Error)	59[2]	16.64	0.78
Total	76[2]		
Calculated F values		2.32*	2.36*

[2] Seven degrees of freedom subtracted for missing value calculations.
* Exceeds the 5% point of significance (F = 1.95)

Results with US Varieties Included in Spreckels Sugar Company Tests in the Salinas, California District

(Data furnished by Spreckels Sugar Co.)

Variety	Alisal Planted 1/8/57 Harvested 8/31/57			Spreckels Planted 1/7/57 Harvested 8/29/57			Greenfield Planted 2/12/57 Harvested 9/28/57			Gilroy Planted 2/4/57 Harvested 9/4/57		
	Acre Yield			Acre Yield			Acre Yield			Acre Yield		
	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent
663H2	11,240	31.22	18.0	7,400	26.44	14.0	11,020	39.49	13.9	11,420	37.12	15.4
672H1	-	-	-	-	-	-	10,120	35.70	14.2	-	-	-
6554H1	-	-	-	-	-	-	10,640	39.40	13.5	-	-	-
US 75	9,800	27.98	17.5	6,260	22.78	13.7	9,440	35.68	13.3	10,300	33.84	15.2
US 56/2	9,380	26.24	17.9	6,240	22.09	14.1	-	-	-	9,640	31.42	15.3
General Mean	9,800	27.80	17.6	6,678	23.84	14.0	10,260	37.98	13.4	10,298	34.29	15.2
S. E. of Mean	230	0.64	0.16	210	0.65	0.18	238	0.79	0.19	222	0.69	0.12
Sig. diff. (19:1)	5[illegible]	1.82	0.44	567	1.23	0.49	668	2.23	0.44	628	1.89	0.34
S. E. of Mean in % of Mean	2.35	2.31	0.88	3.14	2.73	1.25	2.11	2.08	1.43	2.16	2.01	0.79

663H2 = (4547HO X NB1) X 663
672H1 = 5513HO X (Bolt. res. US 35aa X NB4)
6554H1 = 5513HO X NB4

Results with US Varieties Included in the Spreckels Sugar Company Tests in the Sacramento District

(Data Furnished by Spreckels Sugar Company)

Variety	Tudor			Tudor			Dixon			Liberty Island		
	Acre Yield			Acre Yield			Acre Yield			Acre Yield		
	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent
US 400	7,756	25.48	15.25	9,822	40.08	12.28	-	-	-	10,132	35.93	14.10
US 104	6,850	23.23	14.82	10,204	40.56	12.58	-	-	-	-	-	-
US 56/2	5,890	18.57	15.95	8,588	32.52	13.22	9,136	32.12	14.24	8,624	29.43	14.66
674H2	-	-	-	10,144	38.25	13.28	-	-	-	-	-	-
674H1	-	-	-	9,856	38.18	12.92	-	-	-	-	-	-
6507H3	-	-	-	-	-	-	10,836	37.26	14.51	-	-	-
General Mean	7,292	24.25	15.09	9,804	38.34	12.82	9,770	34.94	13.97	9,862	34.19	14.43
S. E. of Mean	436	1.43	0.22	272	1.03	0.19	334	1.13	0.13	244	0.83	0.12
Sig. diff (19:1)	1,264	4.14	0.64	768	2.88	0.54	952	3.23	0.37	694	2.33	NS
S. E. of Mean in % of Mean	5.98	5.90	1.46	2.77	2.69	1.48	3.42	3.23	0.93	2.47	2.43	0.83

674H1 = 461HO X US 201B
674H2 = (MS of NB1 X NB3) X US 201B
6507H3 = (MS of NB1 X NB3) X 6507mm

Results with US Varieties Included in Spreckels Sugar Company Tests in The San Joaquin District

(Data Furnished by Spreckels Sugar Co.)

Variety	Dos Palos			Mendota			Bakersfield			Patterson		
	Acre Yield			Acre Yield			Acre Yield			Acre Yield		
	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent	Sugar Pounds	Beets Tons	Sucrose Percent
US 75	5,808	18.26	15.92	6,664	25.80	12.95	3,878	18.68	10.34	5,692	16.47	17.28
US 22/4	6,400	20.10	15.91	6,040	24.89	12.30	-	-	-	6,380	18.71	17.16
US 22/3	5,736	18.04	15.92	6,294	25.10	12.70	-	-	-	-	-	-
581H1	-	-	-	5,866	22.66	12.98	-	-	-	-	-	-
663H1	-	-	-	-	-	-	4,938	23.24	10.64	7,664	22.16	17.60
6577H1	-	-	-	-	-	-	-	-	-	5,610	16.39	17.24
General Mean	6,238	19.33	16.14	6,278	24.48	12.92	4,500	21.10	10.58	6,366	18.28	17.45
S. E. of Mean	320	0.95	0.21	532	1.96	0.32	158	0.64	0.24	448	1.20	0.21
Sig. diff. (19:1)	NS	NS	0.59	1,528	5.66	0.90	446	1.82	0.67	1,268	3.40	0.58
S. E. of Mean in % of Mean	5.13	4.91	1.30	8.48	8.01	2.44	3.51	3.03	2.21	7.04	6.56	1.18

581H1 = (MS of NB1 X NB3) X NB, CT sel. US 35
663H1 = (MS of NB1 X NB3) X 663
6577H1 = 5570-49-11H1mm X 6577

Descriptions for Varieties Included in Summary Tables

663H1	= (MS of NB1 x NB3) x NB, CT sel. (US 15 x US 22/3)
663H2	= (4547HO x NB1) x NB, CT sel. (US 15 x US 22/3)
581H2	= (MS of NB1 x NB2) x NB, CT sel. US 35
F56-66H2	= (MS of NB1 x NB2) x NB sel. US 35
581H1	= (MS of NB1 x NB3) x NB, CT sel. US 35
F56-66H3	= (MS of NB1 x NB3) x NB sel. US 35
5509H1	= MS of NB1 x NB3
6577H2	= (MS of NB1 x NB2) x 6577 inbred
672H1	= 5513HO x (US 35aa x NB4) (Mildew res. hybrid)
6554H1	= 5513HO x NB4 (Mildew res. hybrid)
6507H3	= (MS of NB1 x NB3) x 6507mm
674H1	= 461HO x US 201B
674H2	= (MS of NB1 x NB3) x US 201B

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For summaries of varietal performances, see pages 62 and 62a.

For results of individual experiments, see pages 63 thru 67.

Gross sugar yields of bolting resistant hybrids and commercial varieties in 1957 California variety tests expressed in percent of the yield of US 75

Location	Testing Agency	US 75	US 56/2	663H1	663H2	581H2 or F56-66H2	581H1 or F56-66H3	5509H1	6577H2	672H1	6554H1	6507H3	674H1	674H2
Coastal Area														
Salinas	USDA	100	97	-	116	-	-	-	-	101	100	-	96	-
Spreckels	Spreckels	100	100	-	118	-	-	-	-	-	-	-	-	-
Alisal	"	100	96	-	115	-	-	-	-	-	-	-	-	-
Greenfield	"	100	-	-	117	-	-	-	-	107	113	-	-	-
Gilroy	"	100	94	-	111	-	-	-	-	-	-	-	-	-
King City	Union	100	99	114	116	102	105	-	102	96	104	107	-	-
San Ardo	"	100	100	113	117	106	111	-	106	112	102	-	-	-
Betteravia	"	100	81	112	127	112	107	-	105	119	-	114	-	-
Alvarado	Holly	100	100	-	-	117	103	-	-	-	-	-	-	-
San Joaquin Valley														
Patterson	Spreckels	100	-	135	-	-	-	-	-	-	-	-	-	-
Bakersfield	"	100	-	127	-	-	-	-	-	-	-	-	-	-
Mendota	"	100	-	-	-	-	88	-	-	-	-	-	-	-
Tulare	Holly	100	93	119	123	109	108	108	-	-	-	-	-	-
Tracy	"	100	69	111	-	108	99	110	85	-	-	103	-	-
Sacramento Valley														
Tudor	Spreckels	-	-	-	-	-	-	-	-	-	-	-	115[1]	118[1]
Dixon	"	-	-	-	-	-	-	-	-	-	-	119[1]	-	-
Gerber	Holly	100	92	-	-	-	-	-	-	-	-	-	99	107
Hamilton City	"	100	94	-	-	123	107	-	-	-	-	-	-	-
Davis	U.of Calif.	100	-	-	-	-	-	109	-	-	-	-	-	-
Imperial Valley														
Brawley	USDA	100	97	121	115	-	108	-	107	97	-	118	89	100
Imp. Val.-Early	Holly	100	98	114	109	-	-	-	-	-	-	-	-	-
Imp. Val.-Late	"	100	98	120	119	113	107	-	-	-	-	-	-	-

1/Expressed in percent of yield of US 56/2

Sucrose percentages of bolting resistant hybrids and commercial varieties in 1957 California variety tests.

Location	Testing Agency	US 75	US 56/2	663H1	663H2	581H2 or F56-66H2	581H1 or F56-66H3	5509H1	6577H2	672H1	6554H1	6507H3	674H1	674H2
Coastal Area														
Salinas	USDA	16.1	16.1	-	16.6	-	-	-	-	16.1	15.3	-	15.9	-
Spreckels	Spreckels	13.7	14.1	-	14.0	-	-	-	-	-	-	-	-	-
Alisal	"	17.5	17.9	-	18.0	-	-	-	-	-	-	-	-	-
Greenfield	"	13.3	-	-	13.9	-	-	-	-	14.2	13.5	-	-	-
Gilroy	"	15.2	15.3	-	15.4	-	-	-	-	-	-	-	-	-
King City	Union	15.6	16.2	16.2	16.4	16.4	16.3	-	16.4	16.2	15.6	16.2	-	-
San Ardo	"	11.9	13.1	12.7	13.1	13.1	13.3	-	12.7	13.7	12.7	-	-	-
Betteravia	"	13.7	13.9	14.0	15.0	14.1	14.7	-	14.2	14.6	-	14.3	-	-
Alvarado	Holly	14.4	15.1	-	-	15.9	14.8	-	-	-	-	-	-	-
San Joaquin Valley														
Patterson	Spreckels	17.3	-	17.6	-	-	-	-	-	-	-	-	-	-
Bakersfield	"	10.3	-	10.6	-	-	-	-	-	-	-	-	-	-
Mendota	"	13.0	-	-	-	-	13.0	-	-	-	-	-	-	-
Tulare	Holly	14.1	14.6	15.1	15.0	15.3	14.8	14.8	-	-	-	-	-	-
Tracy	"	13.6	14.7	14.6	-	14.7	14.9	14.6	14.9	-	-	15.3	-	-
Sacramento Valley														
Tudor	Spreckels	-	13.2	-	-	-	-	-	-	-	-	-	12.9	13.3
Dixon	"	-	14.2	-	-	-	-	-	-	-	-	14.5	-	-
Gerber	Holly	12.9	12.6	-	-	-	-	-	-	-	-	-	12.5	13.2
Hamilton City	"	13.6	14.0	-	-	14.2	14.5	-	-	-	-	-	-	-
Davis	U.of Calif.	11.4	-	-	-	-	-	11.4	-	-	-	-	-	-
Imperial Valley														
Brawley	USDA	16.6	16.9	16.8	16.9	-	16.9	-	16.9	16.6	-	16.8	16.9	16.4
Imp. Val. -Early	Holly	16.5	17.0	17.3	16.8	-	-	-	-	-	-	-	-	-
Imp. Val. -Late	"	13.8	14.1	14.3	14.2	15.3	14.6	-	-	-	-	-	-	-

Variety Test Conducted by Holly Sugar Corporation

Reported by D. D. Dickenson

VARIETY TEST 1957 Tracy, California

CTR Cooperator: John Paulson

Variety	Source	Gross Sugar	% T.J.P.	Tons	% Sucrose	No. Beets Per 100'Row	% Curly-Top
663H1	(NB1MS x NB3) x 663	10029	94.51	34.370	14.59	219	19
5509H1	NB1MS x NB3	9968	96.03	34.206	14.57	230	4
US 22/3	Lot 406	9809	94.60	34.227	14.33	200	9
581H2	(NB1MS x NB2) x 581	9759	94.38	33.283	14.66	186	12
663	NB CT Sel. (US 15 x US 22/3)	9601	94.02	33.407	14.37	216	41
672H2	(NB1MS x NB3) x C681N	9501	94.56	33.453	14.20	186	21
F 56-79	C 579	9485	94.89	33.422	14.19	201	12
F 56-68	F 55-68	9384	93.32	32.811	14.30	200	14
5512H2	NB US35/2aa x 5512	9357	94.01	33.133	14.12	205	4
6507H3	(NB1MS x NB3) x 6507mm	9264	96.07	30.334	15.27	210	28
F55-68	C 268	9256	93.40	33.129	13.97	201	14
F56-66H2	C5511H1 x C 366	9134	94.70	30.125	15.16	195	12
US 75	C 468	9032	93.19	33.305	13.56	206	13
F56-66H3	C5509H1 x C366	8932	95.30	30.053	14.86	201	7
US 35/2	Lot 405	8731	94.14	29.575	14.76	201	12
6577H2	NB1MS x NB2 x 6577	7682	94.12	25.778	14.90	180	6
6516H1	5515H0 mm x 6516	6482	94.60	21.722	14.92	190	92
US 56/2	Lot 618	6221	94.00	21.219	14.66	192	91
Dif. Req. (5%)		717	1.12	2.150	.58		

Remarks: Reliable test. Curly top infection occured at an early stage of growth and reduced yields of those varieties lacking resistance.

Above results extracted from a test of 42 varieties.

Variety Test Conducted by Holly Sugar Corporation

Reported by D. D. Dickenson

Variety Test 1957 Tulare, California

CTR Cooperator: Lester Travis

Variety	Source	Gross Sugar	T.J.P. %	Tons	% Sucrose	No. Beets per 100' Row
663H2	(4547HO x NB1) x 663	10908	93.71	36.361	15.00	223
663H1	(NB1MS x NB3) x 663	10587	94.60	35.009	15.12	214
672H2	(NB1MS x NB2) x (US35/2 aa x NB4)	9686	91.92	34.323	14.11	167
F56-66H2	(NB1 MX x NB2) x C366	9663	93.49	31.537	15.32	201
5509H1	NB1MS x NB3	9626	93.97	32.543	14.79	195
F56-66H3	(NB1MS x NB3) x C366	9592	93.69	32.405	14.80	211
US 22/3	829	9541	94.21	33.502	14.24	215
US 35/2	Lot 405	9167	93.44	30.887	14.84	182
F56-79	C579	9078	92.52	32.727	13.87	209
F56-68	F55-68	8984	92.64	31.502	14.26	211
US 75	468	8877	92.58	31.525	14.08	190
6516H1	5515HO x 6516	8514	92.92	27.607	15.42	184
F55-68	C268	8141	92.76	29.647	13.73	214
US 56/2	Lot 618	8266	92.82	28.406	14.55	201
Sig. Dif. (5%) L S D		800	1.16	2.319	.64	

Remarks: Reliable test. Disease not a factor affecting yields.

Above results extracted from a test of 30 varieties

Variety Tests Conducted by Holly Sugar Corporation

Reported by D. D. Dickenson

VARIETY TEST 1957 Gerber, California

LSR-CTR Cooperator: Dean Glatz

Variety	Source	Gross Sugar	Tons per Acre	% Sucrose	LSR Index 1-10	No. Beets per 100' Row
674 H2	(NB1 MS x NB3) x 674	9598	36.466	13.16	3.8	193
673 H1	461 HO x 673	9137	35.718	12.79	3.9	189
US 75	C 468	8959	36.240	12.36	5.8	196
674 H1	461 HO x 674	8896	35.641	12.48	4.2	192
US 22/3	Lot 406	8874	37.318	11.89	6.7	195
US 35/2	Lot 405	8634	34.316	12.58	5.9	198
US 56/2	Lot 618	8225	32.664	12.59	7.1	202
Dif. Req. for Sig. (5%)		808	2.377	.71		

Remarks: Cercospora leaf spot occured in late October and probably did not affect yield or sugar percentage. Yield data reliable.

Above results extracted from a test of 30 varieties.

VARIETY TEST 1957 Hamilton City, California

CTR Cooperator: George Stutz

Variety	Source	Sugar	% T.J.P.	Tons per Acre	% Sucrose	No. Beets per 100'Row
F 56-66H2	(NB 1 MS x NB 2) x C366	9312	95.43	32.858	14.17	195
F 56-66H3	(NB 1 MS x NB 3) x C 366	8140	96.00	28.049	14.51	202
US 22/3	829	7836	95.18	29.637	13.22	212
F 56-68	F 55-68	7779	94.29	28.143	13.82	194
F 56-79	C 579	7712	94.88	28.004	13.77	198
US 75	C 468	7580	94.01	27.969	13.55	206
US 35/2	Lot 405	7500	95.63	26.541	14.13	206
F 55-68	C 268	7275	94.69	27.703	13.13	209
US 56/2	Lot 618	7159	94.30	25.494	14.04	206
Diff. req. for Sig. (5%)		808	1.14	5.574	.62	

Remarks: Reliable test. Disease not a factor affecting yields.

Above results extracted from a test of 36 varieties.

Variety Tests Conducted by Holly Sugar Corporation

Reported by D. D. Dickenson

VARIETY TEST 1957 Alvarado, California

CTR - 1st Planting Cooperator: F. A. Wilcox

Variety	Source	Acre Yield Gross Sugar	Tons	% Sucrose	No. Beets per 100' Row	% Bolters
581H2	(MS NB1 x NB2) x 581	10345	34.073	15.18	165	.4
Cal A6110	C5511H1 x C366	9518	31.361	15.18	196	0
5511H1	MS NB1 x NB2	9402	31.010	15.16	187	.1
F56-79	C-579	9304	32.316	14.40	197	.1
F56-68	Lot 6326	9219	30.958	14.89	205	0
581H1	(MS NB1 x NB3) x 581	9117	30.854	14.78	156	.1
US 75	C-368	8853	30.709	14.42	207	0
US 56/2	SL 859	8813	29.212	15.09	209	.04
Sig. Diff. (5%)		490	1.362	.43		

Remarks: Reliable test. Disease not a factor affecting yields.

Above results extracted from a test of 20 varieties.

VARIETY TEST 1957 Imperial Valley

NB - CTR 2nd Planting Cooperator: Nelson Coral

Variety	Source	Gross Sugar	% T.J.P.	Tons	% Sucrose	No. Beets per 100'Row
C 663H1	(NB1MS x NB3) x C663	12579	94.40	43.861	14.34	175
C 663H2	(4547HO x NB1) x C663	12486	93.87	43.873	14.23	179
Cal A6110	C5511H1 x C366	11921	94.48	39.010	15.28	168
C 663	NB CT US 15 x US 22/3	11862	93.78	41.973	14.13	171
Cal A6111	C5509H1 x C366	11243	93.49	38.584	14.57	167
F56-79	C579	11099	94.16	37.804	14.68	179
F55-68	C268	10993	92.38	39.486	13.92	182
F56-68	F55-68	10561	92.89	37.135	14.22	180
US 75	C468	10521	92.51	38.229	13.76	182
US 56/2	Comp. Lots 616, 621, 622	10281	93.11	36.407	14.12	180
Sig. Dif. (5%)		645	.85	1.894	.45	

Remarks: Reliable test. Disease not a factor affecting yields.

Above results extracted from a test of 16 varieties.

Variety Test Conducted by Holly Sugar Corporation

Reported by D. D. Dickenson

VARIETY TEST 1957 Imperial Valley

NB-CTR 1st Planting Cooperator: Jack Bros. & McBurney

Variety	Source	Gross Sugar	% T.J.P.	Tons	% Sucrose	No. Beets per 100'Row	% Bolters
61101-03	C5509H1 x H58-55	9688	93.6	29.145	16.62	189	.1
C 663H1	(NB1 x MS x NB3) x C663	9637	94.4	27.917	17.26	194	1.1
61100-02	C5511H1 x H56-55	9569	93.1	28.176	16.98	186	7.7
61112-03	NB 1 MS x SLC 111	9474	94.0	27.398	17.29	196	8.2
61100-01	C4502H0 x H56-55	9465	93.7	28.188	16.75	192	5.2
61101-02	C5511H1 x H58-55	9443	93.4	28.138	16.78	191	.1
61101-01	C4502H0 x H58-55	9437	93.3	27.938	16.89	196	.1
61100-03	C5509H1 x H56-55	9366	93.7	27.891	16.79	186	8.7
61110-04	NB 1 MS x SLC 109	9304	94.0	26.296	17.69	178	9.1
C 663H2	(4547H0 x NB1) x C663	9192	93.1	27.390	16.78	183	0
61111-03	NB 1 MS x SLC 110	9034	93.9	27.278	16.56	183	12.7
HC 1	H58-55 (Lot 6313)	8912	92.3	27.336	16.30	181	.1
Cal A 6110	C5511H1 x C366	8812	93.0	25.047	17.59	191	.2
Cal A 6111	C5509H1 x C366	8646	93.4	24.973	17.31	178	.5
F 56-79	C579 (Lot 6328)	8645	92.7	26.310	16.43	178	.2
C 663	C263 and 363	8562	92.9	25.804	16.59	188	.2
H 58-55	3151 NB lines	8530	92.2	26.491	16.10	183	0
61109-04	NB 1 MS x SLC 108	8485	93.5	25.088	16.91	140	4.6
US 75	C468 (Lot 6255)	8450	92.2	25.684	16.45	191	0
US 56/2	Lots 616, 621, 622	8242	92.9	24.213	17.02	181	.2
Sig. Dif. (5%)		520	.796	1.377	.41		

Remarks: Reliable Test. Disease not a factor affecting yields.

PART IV

VIRUS YELLOWS INVESTIGATIONS

and

BREEDING FOR YELLOWS RESISTANCE

Supported under Foundation Projects 12 and 24

C. W. Bennett J. S. McFarlane

PROJECT 12

BREEDING FOR RESISTANCE TO VIRUS YELLOWS

A survey was made at Salinas, California, in 1957 to determine the relative resistance of our present varieties and breeding stocks to virus yellows. More than 300 varieties, selections, and inbreds from sugar beet breeders in both the United States and Europe were tested. Selections which had been made for virus yellows tolerance by Dr. Raymond Hull of the Rothamsted Experiment Station in England and by Dr. Henk Rietberg of the Instituut voor Rationele Suikerproductie in The Netherlands were included in the tests.

Procedure

Field tests were planted at Salinas, California, on December 17, 1956 and May 7, 1957. The degree of resistance to yellows was determined by comparing inoculated and non-inoculated plots of each variety or breeding stock. Inoculations were made by means of the green peach aphid, Myzus persicae (Sulz.) The aphids were produced on radish plants and transferred to yellows-infected sugar-beet plants 24-48 hours before being transferred to field plants. In making the inoculations, diseased beet leaves infected with aphids, were placed in paper bags after winged individuals had been removed. Leaves were removed from the bags in the field and small pieces, each containing about 10 aphids, were clipped off and allowed to fall on healthy plants. The leaf pieces soon wilted and the aphids moved to the beet plants. The plantings were sprayed with Systox 24-48 hours after inoculation. A virulent strain of the yellows virus (strain 5) was used for all inoculations.

December planting - The December planting consisted entirely of bolting-resistant varieties, selections, and inbreds from the breeding program at Salinas, California. One test in this planting included twelve varieties replicated five times. A second test consisted of 114 inbreds and selections

replicated two times. Each replication of each entry in these tests was divided into two plots, one of which was inoculated with yellows and the second maintained as a check. The plots were two rows wide by 50 feet long in the variety test and one row wide by 22 feet long in the inbred and selection test. Spraying to control the aphid vector was started on March 16 and continued at 10- to 14-day intervals through the month of July. Inoculations were made April 15. The inoculated plots were graded for yellowing and estimates made of percent stunting and necrosis on June 6 and again on June 25. Percent spread of yellows to the non-inoculated plots was also determined on these dates. The tests were harvested August 20 to 23 and data were obtained on yield and sucrose percentage.

<u>May planting</u> - The May planting included a total of 278 varieties, selections, and inbreds. This material was furnished by sugar beet breeders in both the United States and Europe. Each entry was replicated two times and divided into two plots in each replication, one of which was inoculated with yellows and the other maintained as a check. The plots were one row wide by 25 feet long. Spraying for aphid control was started as soon as the plants emerged and was continued until August 15. Inoculations were made on July 1. The plots were graded for yellowing and estimates made of percent stunting and necrosis on August 9 and again on August 21. The plots were harvested September 20-25 and data obtained on yield.

Results

Infection approaching 100 percent was obtained in nearly all inoculated plots in both dates of planting. Aphid populations in the Salinas area were high throughout the growing season and yellows gradually spread to the check rows, even though the plantings were sprayed with Systox at 10- to 14-day intervals. In the December planting, the spread was more rapid in the single-row plots than in the two-row plots. Counts made on June 25 showed 21 percent spread to the checks in the two-row plots as compared with 45 percent spread

in the single-row plots. By harvest time, nearly 100 percent of the check plants in both plantings showed yellows symptoms. In these tests we actually measured the difference between plots which were inoculated with a virulent strain of the yellows virus when the plants were young and plots which gradually became infected by natural spread.

Variation in resistance to damage from yellows - Reductions in yield and sucrose percentage for the twelve varieties included in the December planting are shown in tables 1 and 2. The reduction in yield of roots ranged from 24.7 to 36.8 percent. This difference was highly significant and showed that differences existed among varieties for yellows resistance. The loss in sucrose percentage from yellows was not significantly different among the twelve varieties.

Table 1. Effect of virus yellows on the performance of sugar beet varieties at Salinas, California.
(Planted December 17, 1956 and harvested August 20-23, 1957.)

Variety No.	Description	Acre Yield Gross Sugar Check	Acre Yield Gross Sugar Yellows	Acre Yield Beets Check	Acre Yield Beets Yellows	Sucrose Check	Sucrose Yellows	Bolting Check	Bolting Yellows	Harvest Count Check	Harvest Count Yellows
		Pounds	Pounds	Tons	Tons	Percent	Percent	Percent	Percent	Number	Number
663H2	(4547HO x NB1) x 663	11,891	7,373	35.92	23.84	16.56	15.50	0.1	0	165	159
6577H1	5570-49-11H1 = 6577	11,759	7,261	34.09	22.98	17.22	15.86	1.4	1.0	142	135
616	Price's virus yel. sel. US75	11,693	7,813	36.77	25.16	15.96	15.54	1.8	0.6	151	149
5554H1	MS of NB1 x NB4	10,961	6,424	34.09	21.58	16.08	14.90	0.8	0.1	152	157
663	NB, CT sel. (US15 x US22/3)	10,310	6,700	32.25	22.03	15.94	15.20	0	0	158	162
672H1	5513HO x (US35/2aa x NB4)	10,280	6,790	32.00	22.48	16.10	15.10	0.8	0.5	161	172
515	Price's virus yel. sel. US75	10,245	6,125	32.88	20.96	15.60	14.62	2.2	0.4	159	164
368	US75	10,222	6,021	31.86	19.90	16.06	15.16	0.1	0	164	163
6554H1	5513HO x NB4	10,184	6,496	33.44	22.18	15.26	14.66	0.1	0.1	158	157
511	Greenhouse virus yel. sel. US75	10,028	6,600	31.11	21.59	16.12	15.26	0.1	0.1	164	151
459	US56/2	9,781	7,001	30.39	22.11	16.12	15.82	0.7	0.7	167	169
674H1	461HO x Bolt. res. sel. US201B	9,763	7,183	30.08	23.23	15.88	15.44	12.9	9.2	168	160
General MEAN of all varieties		10,593	6,816	32.97	22.34	16.08	15.26			Beets per 100 feet of row	
S. E of MEAN		461	349	1.08	1.41	0.23	0.23				
Significant Difference (19:1)		1,317	996	NS	NS	0.65	0.64				
S. E. of MEAN in % of MEAN		4.35	5.12	3.28	6.31	1.43	1.51				

Odds 19:1 = 2.02 $\sqrt{2}$ x Standard Error of Mean

VARIANCE TABLE

Variation due to	Degrees of Freedom	MEAN SQUARES Tons Gross Sugar Check	Tons Gross Sugar Yellows	Tons Beets Check	Tons Beets Yellows	Percent Sucrose Check	Percent Sucrose Yellows
Between varieties	11	3,027,625	1,407,385	9.36	19.74	1.14	0.81
Between replications	4	3,480,833	2,715,562	38.15	53.63	0.91	0.75
Remainder (Error)	44	1,062,276	607,915	5.88	9.99	0.26	0.25
Total	59						
Calculated F values		2.85**	2.32*	1.59	1.98	4.38**	3.19**

* Exceeds the 5% point of significance (F = 2.01) ** Exceeds the 1% point of significance (F = 2.68)

Table 2. Reduction in yield and sucrose percentage of sugar beet varieties when inoculated with the yellows virus at Salinas, California in 1957.

Variety	Description	Reduction in Yield: Gross Sugar	Reduction in Yield: Tons per Acre	Reduction in Sucrose
		Percent	Percent	Percentage Points
674H1	461HO x Bolt. res. sel. US201B	26.7	24.7	0.62
459	US56/2	30.1	26.6	0.36
663	NB, CT sel. US15 x US22/3	32.1	31.1	0.74
616	Price's virus yel. sel. US75	33.4	31.7	0.44
672H1	5513HO x (US35/2aa x NB4)	33.7	29.3	1.00
511	Greenhouse virus yel. sel. US75	34.1	30.5	0.86
6554H1	5513HO x NB4	36.5	34.0	0.60
663H2	(4547HO x NB1) x 663	37.8	33.7	1.14
6577H1	5570-49-11H1 x 6577	38.1	32.8	1.40
515	Price's virus yel. sel. US75	40.0	36.1	0.98
368	US75	41.1	37.6	0.90
5554H1	MS of NB1 x NB4	41.4	36.8	1.18
General MEAN of all varieties		35.4	32.1	0.85
S. E. of MEAN		2.80	2.64	0.28
Significant Difference (19:1)		8.01	7.55	NS
S. E. of MEAN in % of MEAN		7.91	8.22	3.29

Odds 19:1 = 2.02 $\sqrt{2}$ x Standard Error of Mean

VARIANCE TABLE

Variation due to	Degree of freedom	MEAN SQUARES: Gross sugar	Tons beets	Sucrose
Between varieties	11	102.80	77.57	0.488
Between replications	4	22.88	18.63	0.645
Remainder (Error)	44	39.33	34.91	0.389
Total	59			
Calculated F values		2.61*	2.22*	1.25

* Exceeds the 5% point of significance (F = 2.01)
** Exceeds the 1% point of significance (F = 2.68)

Yield reductions from yellows among 80 inbred lines included in the December planting ranged from 10.4 to 55.5 percent. The losses for a representative group of inbreds are shown in table 3. Stands were irregular in several of the inbreds so percent yield reductions were computed from average root weights rather than from plot weights. Yield reduction varied greatly between replications and it will be necessary to retest the more promising inbreds to determine their true resistance.

Table 3. Results with a representative group of yellows inoculated vs. non-inoculated inbreds in a December 17, 1956 planting at Salinas, Calif.

	Replication 1			Replication 2			Average
	Ave. Wt. per Beet		Reduction	Ave. Wt. per Beet		Reduction	reduction
Inbred	Check	Yellows	in yield	Check	Yellows	in yield	in yield
	Pounds	Pounds	Percent	Pounds	Pounds	Percent	Percent
5512	1.16	1.11	4.3	1.16	.97	16.4	10.4
5543-16C2	1.45	1.20	17.2	1.33	1.23	7.5	12.4
5577-2	1.49	1.16	22.2	1.59	1.47	7.5	14.9
5544C2	1.24	1.08	12.9	1.30	1.05	19.2	16.1
6613C2	1.61	1.31	18.6	2.03	1.65	18.7	18.7
US201B	1.61	1.15	28.6	1.38	1.14	17.4	23.0
5502	1.31	.98	25.2	1.45	1.10	24.1	24.7
6554	1.14	.86	24.6	1.29	.94	27.1	25.9
6705-10C2	2.05	1.45	29.3	1.81	1.32	27.1	28.2
6607	1.37	.94	31.4	1.63	1.11	31.9	31.7
6610	1.24	.83	33.1	1.37	.88	35.8	34.5
5511	1.49	.76	49.0	1.77	1.11	37.3	43.2
5539-26C2	1.98	1.08	45.5	1.96	1.08	44.9	45.2
5520	1.14	.43	62.3	1.05	.54	48.6	55.5

Yield reductions in the May 7 planting were more severe than in the December planting. Yield losses for 165 inbreds ranged from 9.3 to 65.8 percent. Those for 92 varieties and selections ranged from 10.8 to 49.1 percent. Yield reductions for representative groups of inbreds and varieties are shown in tables 4 and 5. Percent yield reductions were also found to vary greatly between replications in the May planting so it will be necessary to retest the more promising inbreds and varieties.

Table 4. Comparative yields of a representative group of yellows inoculated vs. non-inoculated inbreds in a May 7, 1957 planting at Salinas, California.

Inbred	Replication 1 Acre Yield Check	Replication 1 Acre Yield Yellows	Replication 1 Reduction in yield	Replication 2 Acre Yield Check	Replication 2 Acre Yield Yellows	Replication 2 Reduction in yield	Average reduction in yield
	Tons	Tons	Percent	Tons	Tons	Percent	Percent
FI287	20.0	18.1	9.3	22.2	20.2	9.2	9.3
5-148	20.0	17.9	10.3	20.5	17.2	16.4	13.4
SL6332	21.1	16.1	23.9	16.1	14.6	9.3	16.6
SL6509	13.8	11.2	18.9	18.9	15.7	16.8	17.9
FI299	21.8	18.3	16.2	25.0	19.6	21.6	18.9
ACSI5G	25.2	19.4	23.0	24.8	18.3	26.3	24.7
FI282	14.2	9.9	30.3	18.7	13.6	27.0	28.7
FI270	15.3	10.5	31.7	18.7	13.3	29.0	30.4
SL618	15.5	9.7	37.3	15.3	10.3	32.9	35.1
6554	14.9	7.7	48.8	20.4	12.1	40.4	44.6
SL614	15.3	8.2	46.3	17.4	9.5	45.2	45.8
5502	18.1	9.3	48.5	19.0	10.1	47.1	47.8
6-281	15.1	7.5	50.6	16.4	7.5	54.5	52.5
5511	20.4	8.6	57.8	19.0	8.4	55.9	56.8
5508-113	11.9	4.1	65.6	9.9	3.4	66.0	65.8

Table 5. Comparative yields of a representative group of yellows inoculated vs. non-inoculated varieties in a May 7, 1957 planting at Salinas, California.

Variety	Replication 1 Acre Yield Check	Replication 1 Acre Yield Yellows	Replication 1 Reduction in yield	Replication 2 Acre Yield Check	Replication 2 Acre Yield Yellows	Replication 2 Reduction in yield	Average reduction in yield
	Tons	Tons	Percent	Tons	Tons	Percent	Percent
US15	24.8	23.0	7.5	26.5	22.8	14.1	10.8
56-1021-0	22.8	19.4	14.8	23.9	19.4	18.8	16.8
A7/S1	31.2	28.8	7.8	28.9	21.3	26.5	17.2
20650-0	25.8	20.2	21.7	20.7	16.6	19.8	20.8
674H3	25.4	18.5	27.2	22.8	17.8	22.1	24.7
US400	23.2	17.4	25.0	25.4	19.0	25.0	25.0
586	19.6	14.4	26.7	24.3	18.1	25.4	26.1
US56/2	21.8	15.9	27.4	22.0	15.7	28.8	28.1
5511H1	26.1	17.2	34.3	27.6	19.8	28.4	31.4
Klein Z	23.9	16.1	32.8	22.6	15.7	30.6	31.7
563H1	28.8	19.8	31.2	29.3	19.8	32.5	31.9
5512H1	27.3	15.5	43.2	27.4	18.3	33.3	38.3
5554H1	28.2	15.5	45.0	30.2	19.8	34.6	39.8
K5-41	37.2	17.7	52.3	26.9	14.7	45.1	48.7
Klein E	26.5	15.1	43.0	31.2	14.0	55.1	49.1

Variation in susceptibility to infection - The 1957 tests provided an opportunity to determine the relative resistance of the various varieties and inbreds to natural infection with yellows. In unsprayed beet fields around Salinas, yellows infection approaching 100 percent frequently occurs early in the growing season. In the 1957 tests, aphid buildups were prevented by spraying regularly with Systox. Infection which did occur was primarily from wind-borne, winged aphids and therefore occurred at a much slower rate than in unsprayed fields. This made it possible to detect and measure differences in susceptibility to infection. Counts made in the December variety test showed that infection among the twelve varieties ranged from 13.6 to 27.5 percent to June 25 (table 6.) This difference was highly significant. There was no relationship between resistance to infection and resistance to damage from yellows.

Percent natural infection ranged from 14.9 to 83.9 percent among the 80 inbreds included in the December planting. Variation in spread of yellows among a representative group of these inbreds is shown in table 7. Monogerm inbreds derived from crosses with the SLC101 monogerm proved especially susceptible to infection.

Progress in selecting for resistance - Two field selections from US75 made by Charles Price at Riverside, California, and one greenhouse selection made at Salinas were included in the replicated variety test. Yellows reduced the sugar yield of the US75 variety 41.1 percent, whereas the yield of the two field selections was reduced 33.4 and 40.0 percent. The greenhouse selection showed a yield reduction of 34.1 percent. The difference in the yield reduction between US75 and each of the three selections was not significant. The resistance of the yellows-tolerant selections from England and The Netherlands was not superior to that of several breeding stocks available in the United States.

Table 6. Variation in natural spread of yellows to sugar beet varieties sprayed every 10-14 days with Systox at Salinas, California in 1957.

Variety	Description	Plants infected
		Percent
5554H1	MS of NB1 x NB4	13.6
663H2	(4547H0 x NB1) x 663	14.3
6577H2	5570-49-11H1 x 6577	16.3
616	Price's virus yel. sel. US75	17.5
515	Price's virus yel. sel. US75	19.2
675H1	461H0 x Bolt. res. sel. US201B	22.6
663	NB, CT sel. (US15 x US22/3)	23.6
459	US56/2	24.7
672H1	5513H0 x (US35/2aa x NB4)	25.3
368	US75	25.6
6554H1	5513H0 x NB4	26.2
511	Greenhouse virus yel. sel. US75	27.5
L.S.D. (5%)		7.7

Table 7. Variation in natural spread of yellows to a representative group of inbreds sprayed every 10-14 days with Systox at Salinas, California.

Inbred	Replication 1	Replication 2	Average
	Percent	Percent	Percent
5628-7C2	11.8	18.2	14.9
5628-52C2	19.4	15.0	17.1
6554	28.9	20.0	24.7
6614C2	26.5	29.3	28.0
5502	44.7	24.3	34.7
5628-92C2	35.3	39.4	37.3
6503-13C2	43.8	37.9	41.0
5539-22C2	43.3	45.9	44.8
5543-14C2	50.0	53.3	51.7
5511	46.4	61.5	53.7
6504-15C2	51.5	59.0	55.6
5512	60.0	74.4	68.1
5611	71.4	78.6	74.3
6507-18	76.5	90.0	83.8
6568-146C2	100.0	72.2	83.9

Correlation between yield reduction and top symptoms - Correlation coefficients were computed between reduction in yield from yellows and the top symptoms stunting, yellowing, and necrosis. These coefficients were computed separately for varieties and for inbreds in each of the replications (table 8). In the December planting very little correlation existed between yield reduction and any of the top symptoms. In the May planting a significant positive correlation was found between yield reduction and stunting in both the inbred and variety tests. In one replication, yield reduction was also correlated with yellowing and with necrosis.

Table 8. Correlation coefficients between yield reduction from yellows and the top symptoms stunting, yellowing, and necrosis.

Date of planting	Type of material	Stunting		Yellowing		Necrosis	
		Rep. 1	Rep. 2	Rep. 1	Rep. 2	Rep. 1	Rep. 2
December 1956	Inbreds	.07	.24*	.48**	.19	.12	.09
December 1956	Varieties	-.16	.32	.33	.33	.28	.06
May 1956	Inbreds	.46**	.45**	.26**	.02	.36**	.02
May 1956	Varieties	.59**	.52**	.40**	.04	.51**	.02

* Significant at 5% point.

** Significant at 1% point.

None of these correlation coefficients was high. Yield reduction was most closely associated with stunting but even this association varied greatly from one variety or inbred to another.

The results of these tests show that none of these three top symptoms will serve as a reliable selection criterion. Yellowing and stunting are undesirable characters in a sugar beet variety so preliminary selections can be made for relative freedom from these characters. Unless a reliable biochemical technique can be developed, true resistance can be determined only through yield comparisons of yellows-infected and non-infected beets. The necessity of using yield measurements to determine resistance will limit the size of populations which can be handled in a breeding program and add greatly to the cost of developing resistant varieties.

EFFECT OF VIRUS YELLOWS ON YIELD OF SUGAR BEET SEEDS

Introduction

Evidence is accumulating that virus yellows has been a factor in lower seed yields obtained from fields in the Salt River Valley of Arizona during the past three years. The importance of factors, such as curly top alone and in combination with yellows, seasonal effects, and other influences, needs to be determined before the damage caused by yellows can be determined accurately.

Attempts were made, therefore, to study the effects of yellows in the field and in the greenhouse under conditions as nearly controlled as feasible. Field tests were made in the Salt River Valley in cooperation with Entomology Research Division of the United States Department of Agriculture and the Western Seed Production Corporation, and greenhouse and field tests have been made at the U. S. Agricultural Research Station at Salinas, California. The results obtained at Salinas are included in this report.

Greenhouse Test

The study of the effects of virus yellows on seed production offers certain difficulties because of the long period of growth over which the plants are subject to natural infection in areas where seeds are produced and to the difficulty of obtaining satisfactory bolting in other areas where tests may be conducted. For these reasons

the first test was made in a greenhouse with an annual type of beet, seeds of which were collected in the Imperial Valley. In this test, an attempt was made to determine the effects of yellows and curly top alone and in combination, on seed production.

Seedlings were planted in 6-inch pots in the greenhouse and after the plants had attained appreciable size they were divided into 5 lots of 50 plants each and treated as follows:

Lot 1, inoculated with yellows virus in the 8- to 10-leaf stage.

Lot 2, inoculated with yellows virus at the beginning of blossoming.

Lot 3, inoculated with curly top virus in the 8- to 10-leaf stage.

Lot 4, inoculated with both yellows and curly top viruses in the 8- to 10-leaf stage.

Lot 5, check (not inoculated.)

Strain 5 of the yellows virus and strain 3 of the curly top virus were used as inoculum. Both of these viruses have relatively high degrees of virulence on sugar beet.

The annual beet used in this test proved to be very susceptible to both curly top and yellows. Many plants were severely injured and a number failed to produce seeds. The numbers of plants harvested are shown in table 1 with weight of seeds per plant and weight of 100 grams of seeds from plants of the different treatments. The seeds of the annual used in the test evidently have a period of dormancy so it was not possible

to determine viability immediately after harvest. Germination tests will be made at a later date.

Table 1. Results of tests to determine the effects of yellows and curly top, singly and in combination, on seed yield and germination of an annual-type beet from the Imperial Valley of California.

Disease or diseases involved	Plants harvested of 50 inoculated[1]	Average yield of seeds per plant	Weight of 100 seeds
	Number	Grams	Grams
Yellows, early	27	0.57	1.02
Yellows, late	48	0.81	1.23
Curly top	30	0.53	1.12
Curly top + yellows	5	0.14	0.81
Check (noninoculated)	50	1.55	2.49

[1] Non-harvested plants either produced no seeds or died.

It is obvious from results shown in table 1 that both yellows and curly top greatly reduced seed yield and also weight of individual seeds. Yellows caused approximately the same reduction in seed yield as curly top. Actual yield reductions by yellows and curly top were 63.3 and 65.7 percent, respectively. Only 5 of 50 plants inoculated with both viruses produced seeds and the yield of seeds from these plants was less than 10 percent of that from healthy plants.

Field Test

The selection, S.L. 54484-0, obtained from F. V. Owen, was chosen for a test in the field on account of its easy-bolting qualities, in an attempt to obtain further information on the effect of yellows and curly top, alone and in combination, on seed production. The planting was made November 5, 1956. The plots were 12½ feet long and 4 rows wide and plants were thinned to about 6 inches in the row. The following treatments were used:

1. Inoculated with curly top virus strain 3 March 7, using 3 leafhoppers per plant; reinoculated April 16 with 8 leafhoppers per plant.
2. Inoculated with yellows virus strain 5 March 18.
3. Inoculated with yellows virus strain 5 May 13, when the most advanced plants had a few open blossoms.
4. Inoculated with curly top virus strain 3 March 7, with 3 leafhoppers per plant; reinoculated April 16 with 8 leafhoppers per plant. Inoculated with yellows virus strain 5 March 18.
5. Check, not treated.

Each treatment was replicated 4 times. Plants were harvested August 8.

High percentages of infection were obtained in both dates of inoculation with yellows virus. However, the selection S.L. 54484-0 showed unexpected resistance to infection with curly top virus and no infection was obtained. It has since been shown in greenhouse tests

that this selection is rather susceptible to infection in the cotyledon stage but that resistance increases rapidly with age until in the 12- to 14-leaf stage, it acquires a very high degree of resistance, not only to infection but to production of symptoms.

The selection bolted very irregularly in the field. Counts of plants that had bolted by June 13 showed that 51.8 percent of the plants in plots in the first date of inoculation with yellows had bolted as compared to 68.4 in the check plots. However, the number of plants harvested August 8 was not significantly different in the different treatments. This, and other evidence, indicates that yellows delays bolting but probably does not greatly influence the number of plants that eventually produce seed stalks.

The results of this test are shown in table 2. It is evident from these results that the earlier inoculation with yellows virus resulted in an average reduction in yield of about 44 percent which is highly significant statistically. There is a suggestion also that the later infection with yellows may have resulted in some reduction in yield, but the reduction was not very large. The most consistent result was the reduction in weight of individual seeds in plots with the earlier inoculation with yellows. Germination was low with seeds from all plots and there is no evidence that yellows influenced germination. This result is consistent with results from a number of other tests in which no evidence was found that the virus yellows disease caused a reduction in viability of seeds.

Table 2. Results of tests at Spence Field in 1957 with SL 54484-0 to determine the effects of curly top and yellows on seed yield and germination. (Planted Nov. 5, 1956; harvested Aug. 8, 1957)

Plot treatment	Rep. No.	Yield of seeds per plot	Weight of 100 seeds	Germination
		Pounds	Grams	Percent
Yellows - early	1	5.75	1.276	35.75
	2	5.75	1.555	63.25
	3	6.25	1.405	52.75
	4	4.43	1.448	63.50
	Average	5.55	1.421	53.81
Yellows plus curly top[1]	1	5.00	1.312	35.00
	2	6.25	1.545	43.75
	3	5.75	1.429	63.25
	4	4.35	1.448	68.25
	Average	5.34	1.434	52.56
Yellows - late	1	8.75	1.661	54.00
	2	7.50	1.586	56.00
	3	8.75	1.694	76.00
	4	9.25	1.778	64.50
	Average	8.56	1.680	62.63
Curly top[2]	1	11.50	1.672	62.00
	2	8.75	1.688	55.75
	3	9.75	1.645	60.25
	4	7.53	1.748	60.25
	Average	9.38	1.688	59.56
Check (not inoc.)	1	10.75	1.834	54.50
	2	11.50	1.801	58.75
	3	8.00	1.418	50.5
	4	9.71	1.740	69.25
	Average	9.99	1.698	58.25

[1] No curly top infection, should be considered "yellows early".

[2] No curly top infection, should be considered "check".

More results are needed before final conclusions may be reached, with respect to the damage likely to be caused by yellows in commercial varieties of sugar beets being grown for seeds, but evidence thus far indicates that losses may be appreciable if infection occurs before plants begin to produce seed stalks.

PART V

BREEDING FOR NEMATODE RESISTANCE

and

SCREENING TESTS IN FIELD AND GREENHOUSE

Supported under Foundation Projects 13 and 23

Charles Price C. H. Smith

Cooperators in Nematology Section:

A. M. Golden
G. D. Griffin
E. C. Jorgensen

PROJECT 13 - STUDIES IN METHODOLOGY OF EXPOSURE AND BREEDING FOR NEMATODE RESISTANCE

Charles Price

Investigations at Salinas, California, with the support of the Beet Sugar Development Foundation, are concerned primarily with breeding for resistance to sugar beet nematode, and making studies of the nature of nematode resistance in sugar beets and other plants. By the use of a streamlined procedure developed by members of the U. S. Department of Agriculture, Agricultural Research Station at Salinas, California, many thousand sugar beets and other plants have been screened. Selections for resistance have been made on the basis of absence of female nematodes and newly formed cysts on the roots. In the early stages of growth some of the selected sugar beets have shown more vigor and less wilting than the unselected beets. Over one hundred thousand plants have been examined, and of these only a very small amount of material has been selected for possible resistance to sugar beet nematode. The material which has been examined for presence of nematode include commercial varieties, breeding stock, inbred lines, promising monogerm lines, irradiated seed, _Beta_ species, and crosses between sugar beets and _webbiana_, _máritima_, and _patellaris_.

In greenhouse tests at Salinas, and field tests at Salinas and Salt Lake City, Utah, some of the selections made at Salinas and some of the material furnished by the American Crystal Sugar Company were superior in top vigor and root development to the unselected

checks. It is also interesting that in both greenhouse and field tests the stands were much superior to the unselected checks, indicating that increased tolerance to nematode had reduced the mortality of the beets, thus resulting in better stands. In heavily infested soil it has been observed that the beets susceptible to nematode are weakened which makes them more susceptible to damping off fungi and other pathogens, when they are grown in heavily infested nematode soil.

In a test by Mr. C. H. Smith of the Agricultural Research Station at Salt Lake City, Utah, Salinas selections were included in an unreplicated test and the foliar growth was outstanding, as compared with the unselected check. The root growth was also superior in all but one selection in the test. A table of the results is shown which includes only the Salinas selections but, in addition, Mr. Smith's report of the nematode test gives other variety performances.

Irradiated Seed

In examination of the progeny of the first generation after irradiation by means of the greenhouse technique, only two sugar beets showed superiority in vigor and absence of female nematodes on the roots. Most of the material examined had numerous nematodes on the roots and the plants were yellow in color and dwarfed. It will require much work to determine the relation between the effects of irradiation treatments and resistance to sugar beet nematode.

Species Hybrids

Hybrids obtained by crossing sugar beets and Beta webbiana have been backcrossed with sugar beets. The hybrids have been grafted into sugar beets, and work is under way to determine their value in the breeding program.

Cooperative Work with Dr. A. Morgan Golden

In cooperation with Dr. A. Morgan Golden, plans are being formulated to test in the greenhouse, promising nematode-resistant selections in soil in which nematode inoculum from four different locations have been placed.

An experimental field uniformly inoculated with sugar beet nematode cysts is being set up in which promising nematode-resistant selections and breeding material will be tested.

Hesperis matronalis and other crops will be tested to determine their effect on the hatching of nematode and subsequent effect on yield and quality of sugar beets.

Cooperative Work with Dr. J. M. Fife

Studies so far are concerned with exploring the possibility of using paper chromatography as a tool for studying the nature of resistance of plants to sugar beet nematode. Comparative studies are in progress to determine the amino acid composition of various host and non-host plants to the sugar beet nematode in an effort to find a more easy method of selection for nematode resistance.

Results of Field Test in Soil Heavily Infested with Sugar Beet

Nematode near Salt Lake City, Utah 1957

Selections[1]	Acre Yield Gross sugar	Beets	Sucrose
	Pounds	Tons	Percent
592-3 (303)	3,160	22.9	13.8
590-9 (321)	2,820	24.1	11.7
590-8 (322)	1,971	16.7	11.8
590-12 (323)	1,305	12.2	13.8
U.S. 41(028) CK	1,795	13.8	13.7

[1] Selections of sugar beets made at Salinas, California for resistance to sugar beet nematode. The test was by C. H. Smith, Agronomist, Sugar Beet Section, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture at Salt Lake City, Utah.

Variety Test Conducted under Severe Nematode Exposure[1/]
Salt Lake City, Utah, 1957

(Funds from Foundation Project 23 were used to cover part of the cost of this experiment.)

INTRODUCTION

C.H.Smith

A test field was selected in the fall of 1956 which provided an unusually favorable opportunity for field evaluation for nematode resistance in 1957. This test field was located on the Rell Swensen farm at Taylorsville, Utah, a few miles southwest of Salt Lake City. The same field was also selected for studies with different kinds of nemacides and with different rates of application.

Lines of beets especially selected for nematode resistance were obtained from the American Crystal Sugar Company and from the nematode selection program at Salinas, California. For comparative purposes representative lines and hybrids were included from the breeding program at Salt Lake City and Salinas, California.

Prior to thinning, a thorough check of all varieties in all replications was made for the presence of nematodes. Large numbers of nematodes were found throughout the test. The infestation was remarkably uniform. Immediately after thinning, temperatures rose sharply which, combined with the heavy nematode infestation, was so severe on the small beets that the stands were threatened. Irrigation, followed by cooler weather in late June and early July, improved the growth and by August 1 some very striking varietal contrasts were evident. These contrasts continued to harvest time, and fortunately the curly-top exposure was very mild, so curly-top susceptible lines were not greatly discriminated against. These contrasts are shown in Figs. 1 and 2.

On border rows, planted to US 22/4, a fertilizer experiment was conducted with Ammonium Nitrate applications made June 21.

1/ The assistance of E. C. Jorgensen and G. D. Griffin, Nematology Section, Crops Research Division, in conductance of this test, is acknowledged.

NEMATODE RESISTANCE TEST. SALT LAKE CITY, UTAH, 1957

Fig. 1. Inbred lines grown under severe nematode exposure. Photo August 12, 1957.

A. Foreground: Section 2 of experiment.

Row Number ->	2	3	4 & 5	6 & 7	8 & 9	10 & 11
Varieties	US 41	5520	5568-146C2	6503-13C2	6506C2	6507-4 mm
Tons per acre	13.1	2.2	5.2	16.9	5.7	2.2

Inbred 6503-13C2 (Rows 6 & 7), developed by J. S. McFarlane, is highly resistant to mildew and ordinary in inbred vigor. Although not selected for nematode resistance, 6503-13C2 was outstanding among inbreds in this test.

B. Background: Section 1 of experiment.

Row Number ->	1	2	3	4 & 5	6 & 7	8 & 9
Varieties	US 41	590-12	592-3	590-8	590-9	593-3
Tons per acre	13.1	12.2	22.9	16.7	24.1	

Entries 590-12, 592-3, 590-8, and 590-9 are from selections for nematode resistance obtained from screening tests at Salinas, California.

NEMATODE RESISTANCE TEST. SALT LAKE CITY, 1957.

Fig. 2. Variety test under severe nematode exposure. Photographed August 12, 1957.

A. Foreground: Section 4 of experiment.

Row Number ->	2	3 & 4	5 & 6	7 & 8	9 & 10	11
Varieties	C6577H2	C672H1	674H1	F54-4H7	5090H3	6134
Tons per acre	10.2	10.4	11.4	11.5	10.7	6.5

B. Background: Section 3 of experiment.

Row Number ->	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10	11 & 12
Varieties	56-407	56-408	56-409	56-410	55-410	56-412
Tons per acre	12.1	11.6	13.7	11.8	12.8	12.8

Entries as shown in Section 3 were developed in a program of nematode resistance breeding by the American Crystal Sugar Company.

DISCUSSION OF VARIETAL REACTIONS

In the replicated test with seventeen varieties, seven varieties were rather outstanding in foliar growth. This included all six of the selections made by the American Crystal Sugar Company and the unselected US 201B hybrid, 674H1. Harvest yields of these numbers were somewhat disappointing as compared with their luxuriant foliar growth, yet, after ranking varieties on yield of gross sugar, the American Crystal selections took the first five places. The root yield of the US 201B hybrid was more disappointing. The foliar growth of the CT9 hybrid 5090H3 was poor, but the root yield approached that of some of the better numbers. The very vigorous Klein E hybrid, F54-4H7, which yielded 31.4 tons per acre in fumigated soil, yielded only 11.5 tons per acre under the heavy nematode exposure. All evidence indicates significant varietal reactions.

The sixth replication of the replicated variety test was on the west or bottom end of the field where water temporarily ponded after each irrigation. Here growth of most varieties was decidedly better, especially towards the end of the season. For this reason the sixth replication is shown separately and calculated separately.

In the unreplicated observation plots Salinas selection 592-3, although heavily infested with nematodes, showed outstanding seedling growth, equal to the vigorous growth of beets in a nearby fumigated area. The other four Salinas nematode selections showed early seedling retardation and brownish dead side-rootlets, but they recovered later in the season and produced a top growth equal to variety 592-3. Salinas selections are shown in Fig. 1.

The Salinas inbred C6503-13C2, although not selected for nematode resistance, made a remarkable contrast with all other inbreds. The performance of this inbred became more outstanding as the season advanced.

VARIETY TEST ON NEMATODE INFESTED SOIL WITHOUT FUMIGATION
TAYLORSVILLE, UTAH, 1957

Grower: Rell Swensen

Soil type: Welby fine sandy loam

Previous crops: 1952, alfalfa; 1953, grain; 1954, sugar beets; 1955, grain; 1956, sugar beets.

Fertilizers and cultural practices: See variety test on fumigated soil (Project 23).

Planted: May 3, 1957   Thinned: June 5, 1957

Irrigations: First irrigation May 7, 1957. Total of 11 irrigations by furrow.

Harvested: October 13. At harvest the tops were removed with a roto-beater, and scalped with tractor-mounted scalping tools supplemented by long-handled hoe work. Beets were counted before pulling. One fifteen-beet sample was taken from each plot at random for sugar analysis. These samples were weighed after washing in the laboratory to ascertain tare values for each variety.

Experimental design: The beets were planted in 2-row plots with 20 inches between rows. Objective at thinning was 8 to 10 inches but some variations occurred. Four-foot alleys were cut between plots. Effective plot length was 21 feet.

There were three variety groups. One group of seventeen varieties was planted in randomized block design replicated six times. Six of the varieties were selections made by the American Crystal Sugar Company under nematode conditions, and the remainder were of vigorous hybrids or commercial type varieties. A second group of nine inbreds with relatively good vigor under nematode-free conditions were replicated six times in randomized blocks. A US 41 (SL 028) check was placed systematically between replications of groups 1 and 2. A third group consisted of five Salinas greenhouse nematode selections, and ten Salinas inbred lines, not selected for nematode resistance. Seed of numbers in this third group was limited, and therefore, planted in single observation plots without replications.

VARIETY TEST, TAYLORSVILLE, UTAH, 1957

Fumigated Versus Unfumigated Soil with Uniform Heavy Nematode Infestation

VARIETY	UNFUMIGATED SOIL 1/ ACRE YIELD GROSS SUGAR	TONS BEETS	PERCENT SUCROSE	FUMIGATED SOIL 2/ ACRE YIELD GROSS SUGAR	TONS BEETS	PERCENT SUCROSE
56-409 American Crystal	3,678	13.7	13.4	7,762	27.2	14.3
56-412 " "	3,512	12.8	13.7	7,508	25.8	14.5
55-410 " "	3,330	12.8	13.0	6,144	21.0	14.6
56-408 " "	3,266	11.6	14.1	7,876	26.9	14.6
56-410 " "	3,236	11.8	13.8	7,184	23.5	14.8
F54-4H7 CT9 Hyb. X Klein E.Hyb.	3,234	11.5	14.1	9,166	31.4	14.2
56-407 American Crystal	3,220	12.1	13.3	7,538	26.1	14.4
C674H1 461HO X US 201B	3,108	11.4	13.6	6,998	23.7	14.8
5090H3 211H3 X CT9	3,108	10.7	14.5	8,392	31.3	13.4
C672H1 5513HO X 672	2,928	10.4	14.0	8,388	27.4	15.3
028 US 41	2,792	10.6	13.2	7,468	26.2	14.2
6932 91 MS mm X 4n US 35	2,662	9.7	13.7	6,966	23.1	15.1
C5512H2 NB sel. X 5512	2,656	10.9	12.2	7,242	27.3	13.3
C6577H2 3511H1 X 6577	2,510	10.2	12.3	8,512	28.3	15.0
C663H1 3501H1 X 663	2,290	8.8	13.0	8,902	30.3	14.7
U-I E/1 91 MS mm X CT9 Hyb.	2,250	8.1	14.0	7,486	28.0	13.4
6134 MS mm X SLC 122 mm	1,886	6.5	14.5	6,878	22.9	14.8
6229 aa mm X do.	1,704	5.8	14.8	5,972	18.3	16.4
Sig. Diff (LSD 5%)	560	2.2	0.8	1,720	6.6	1.2
Inbred Lines						
F55-8 SLC 108 mm	1,922	6.4	14.9	7,390	28.6	12.9
618 CT5 Subline	1.918	6.8	14.5	5,732	20.4	14.1
6240 SLC 122 mm	1,848	6.3	14.7	6,826	25.6	13.4
4090 New CT9	1,736	6.0	14.6	5,092	18.4	13.9
C5511 NB inbred	1,634	7.1	11.8	4,658	20.0	11.7
5070 CT7 or Line 287	1,234	4.1	15.4	5,476	17.7	15.4
50.158 CT8	1,160	3.8	15.4	5,924	18.7	15.8
C5547 NB Inbred	994	4.3	11.9	4,824	21.3	11.4
C5502 do.	868	3.7	11.6	4,562	19.6	11.6
Sig. Diff (LSD 5%)	500	2.2	1.02	1.380	4.9	0.8

1/ Results on unfumigated soil based on five replications

2/ Results on fumigated soil based on three replications

VARIETY TEST #11, TAYLORSVILLE, UTAH, 1957

Unfumigated Soil with Heavy Nematode Infestation

VARIETY	TONS BEETS PER ACRE — Five Uniform Replications: 1	2	3	4	5	Ave.	Six Replications: Sixth replic.[1/]	Ave. of all six reps.
56-409 American Crystal	15.7	16.7	10.0	14.4	11.7	13.7	12.5	13.5
55-410 " "	13.9	12.7	11.2	13.7	12.7	12.8	10.5	12.4
56-412 " "	13.9	10.7	15.7	13.9	10.0	12.8	14.7	13.2
56-407 " "	13.2	11.0	15.2	11.0	10.2	12.1	12.2	11.7
56-410 " "	13.2	15.9	11.0	9.7	9.0	11.8	14.2	12.2
56-408 " "	14.2	10.2	13.9	9.7	10.2	11.6	16.7	12.5
F54-4H7 CT9 Hyb. X Klein E Hyb.	11.2	11.5	12.5	9.7	12.5	11.5	12.2	11.6
674H1 461H0 X US 201B	14.2	12.5	13.7	9.7	6.7	11.4	13.9	11.8
5512H2 NB sel. US 35 aa X 5512	12.7	9.5	10.5	10.2	11.5	10.9	18.9	12.2
5090H3 211H3 X CT9	12.5	11.7	10.2	9.7	9.5	10.7	22.2	12.6
028 US 41 check	9.7	9.7	12.7	7.5	13.2	10.6	10.7	10.6
672H1 5513H0 X 672	13.2	12.7	8.7	9.2	8.2	10.4	15.7	11.3
6577H2 3511H1 X 6577	12.7	9.2	10.2	7.5	11.5	10.2	12.2	10.6
6932 91 MS mm X 4n US 35	11.2	9.7	10.5	6.7	10.5	9.7	11.0	9.9
663H1 3501H1 X 663	13.4	9.5	9.0	6.0	6.0	8.8	12.2	9.4
U-I E/1 91 MS mm X CT9 Hyb	9.0	7.5	10.2	7.5	6.2	8.1	14.7	9.2
6134 MS mm X SLC 122 mm	7.7	6.2	7.0	6.0	5.5	6.5	8.5	6.8
6229 aa mm X SLC 122 mm	6.2	6.5	6.2	5.0	5.0	5.8	9.7	6.4
MEAN	12.2	10.8	10.9	9.4	9.2	10.5	13.7	11.0
S. E. of MEAN						0.76		0.84
Significant difference (LSD 5%)						2.15		2.36
S. E. of MEAN in % of MEAN						7.22		7.61

[1/] The sixth replication was on the west or bottom end of the field where water temporarily ponded after each irrigation. Here growth of most varieties was decidedly better, especially towards the end of the season.

VARIETY TEST #11, TAYLORSVILLE, UTAH, 1957
UNFUMIGATED SOIL WITH HEAVY UNIFORM NEMATODE INFESTATION

Single Observation Plots not Replicated

VARIETY	ACRE YIELD GROSS SUGAR	ACRE YIELD TONS BEETS	PERCENT SUCROSE
	Salinas Nematode Selections		
592-3 US 33 Selection	3,160	22.9	13.8
590-9 Spreckels S_2 Sel.	2,820	24.1	11.7
590-8 do.	1,971	16.7	11.8
590-12 do.	1,305	12.2	13.8
028 US 41 Check	1,795	13.1	13.7
	Salinas Inbred Lines--Unselected		
C6503-13C2	1,859	16.9	11.0
C5512	1,112	12.2	9.2
C5508	775	6.2	12.5
C6506C2	730	5.7	12.8
C5513	712	5.2	13.7
C5568-146C2	692	5.2	13.3
C6516 mm	480	3.5	13.7
C5520	328	2.2	14.9
C6507-4 mm	308	2.2	14.0
C6554 NB4	218	1.5	14.5

FERTILIZER EXPERIMENT, UNFUMIGATED SOIL, TAYLORSVILLE, UTAH, 1957

Under Severe Nematode Infestation

Replication Number	ACRE YIELD				PERCENT SUCROSE	
	GROSS SUGAR		TONS BEETS			
	Fertilized	Control	Fertilized	Control	Fertilized	Control
1	6,068	5,460	23.7	21.0	12.8	13.0
2	4,150	3,782	15.6	13.8	13.3	13.7
3	3,822	4,040	14.7	15.3	13.0	13.2
4	3,600	3,554	14.4	12.6	12.5	14.1
5	3,288	2,790	12.0	9.0	13.7	15.5
6	2,832	2,570	11.7	12.6	12.1	10.2
7	3,106	3,048	13.5	12.0	11.5	12.7
8	3,660	3,560	15.0	13.8	12.2	12.9
9	2,854	3,124	11.7	11.4	12.2	13.7
10	3,076	4,638	12.3	17.7	12.5	13.1
11	5,424	5,834	20.7	20.4	13.1	14.3
12	5,998	3,906	20.4	12.6	14.7	15.5
Average	3,990	3,859	15.5	14.4	12.8	13.5
Average Diff.	131		1.1		-0.7	
t. value	0.63		1.25		2.28	
Sig. Diff.5%	NS		NS		2.20	

Remarks:

On six border rows in the unfumigated area planted to US 22/4 (F55-92) nitrogen applications were made in alternating 21 ft. blocks with 300 pounds per acre of Ammonium Nitrate (100 N units per acre) on June 21. The nematode population was heavy and the severe root injury was comparable to that in adjoining rows devoted to tests with different varieties. No growth differences, due to fertilizer treatment were noted through the summer. Yield differences between treated and untreated plots in the twelve replications were not significant. Sucrose percentage, slightly depressed by the Nitrogen treatment, was barely significant at the five percent point, based on "Students" pairing method.

PART VI

PRODUCTION OF BASIC BREEDING MATERIAL

and

METHODS OF BREEDING

including

RHIZOCTONIA RESISTANCE

Supported under Foundation Project 25

LeRoy Powers J. W. Dudley

J. O. Gaskill

PROGRESS REPORT TO THE BEET SUGAR DEVELOPMENT FOUNDATION ON THE GENETIC AND PLANT BREEDING PHASES OF PROJECT NUMBER 25[1]

January 8, 1958

by LeRoy Powers and John W. Dudley

The population genetic studies at different levels of soil fertility and the studies pertaining to the identification of genetically-superior individuals in sugar beet breeding programs have provided information that may be of interest to the members of the Beet Sugar Development Foundation.

Population Genetic Studies at Different Levels of Soil Fertility

The information on population genetic studies will be discussed under two groups of characters. The first group of characters discussed will be percentage sucrose, parts per million of NO_3-N in the petioles, and weight per root, and the second group of characters discussed will be parts per one hundred thousand of potassium and parts per one hundred thousand of sodium.

Percentage Sucrose, Parts per Million of NO_3-N in the Petioles and Weight per Root

The data for the group of characters percentage sucrose, parts per million of NO_3-N in the petioles, and weight per root will be analysed under the headings: main effects, first order interactions, and second order interactions.

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[1] The population genetic studies at different levels of soil fertility is cooperative with the Agronomy Department of Colorado State University. The potassium and sodium determinations were made by the Holly Sugar Corporation.

Main Effects

The means of the main effects are listed in table 1. The replications have been collected into five groups, each composed of 8 replications. The purpose of this grouping was to more clearly portray differences between replications as regards parts per million of NO_3-N in the petioles and to more clearly portray the relation between this character, percentage sucrose and weight per root.

Table 1. Means of percentage sucrose, parts per million NO_3-N in the petioles, and weight per root for replications, populations, and treatments.

Main effects	Sucrose	NO_3-N	Weight
	%	Ppm	Lbs.
Replications			
1-8	17.3	818	1.72
9-16	17.9	653	1.60
17-24	17.7	729	1.49
25-32	17.1	1685	1.59
33-40	15.8	8909	1.77
Populations			
A54-1	17.3	2985	2.26
A54-1 BB	17.3	3238	2.18
50-406 BB	17.4	2879	1.72
50-406	16.8	1630	0.89
F_1 hybrid	17.6	2172	1.88
52-307	16.6	2448	0.87
Treatments			
Fertilized	16.8	3731	1.95
Non-fertilized	17.5	1386	1.32
Mean	17.2	2559	1.63

The analysis of variance for the three characters revealed that there were significant differences between means of replications, populations, and treatments for all 3 characters.

Probably of greatest importance is a comparison between the means involving the F_1 hybrid and the two inbred parents, 50-406 and 52-307. The value of *t* is used to test the significance of the difference between the mean of the F_1 hybrid and 50-406, the inbred parent having the highest percentage sucrose. The difference in favor of the F_1 hybrid as can be determined from the data of table 1 is 0.8 percent. The standard error of the difference is 0.3080, *t* is 2.60, and P is approximately 0.01. Hence, the percent sucrose of the F_1 hybrid is significantly higher than that of either parent. Heterosis is definitely expressed in the F_1 hybrid involving the inbred lines 50-406 and 52-307. These data were taken from the experiment conducted in 1956. In a 12 X 12 latin square test conducted in 1957 the percentage sucrose for the F_1 hybrid between these same two inbreds was higher than that of either parent. It follows that heterosis for percentage sucrose does occur in certain hybrids under the conditions existing on the Agronomy Farm of Colorado State University and the growing seasons of 1956 and 1957. Similar results have been obtained (unpublished) by Rush and Oldemeyer of the Amalgamated Sugar Company. It seems that heterosis for percentage sucrose in some F_1 hybrids involving inbred lines of sugar beets may not be uncommon. This fact may prove to be of considerable economic importance in the production of beet sugar.

Another interest in the means listed in table 1 is the interrelation between the three characters. Without exception a decrease in parts per million of NO_3-N in the petioles is accompanied by an increase in the percentage sucrose. The same trend holds for percentage sucrose and weight of root. As might have been expected, there is a tendency for weight of root and parts per million of NO_3-N in the petioles to be positively associated. These same conclusions hold for a comparison of the means listed under treatments.

The relation noted between percentage sucrose and parts per million of NO_3-N in the petioles for replications and treatments does not seem to hold so well for populations. However, a tendency for a positive relation between weight per root and NO_3-N does exist.

A comparison between the F_1 hybrid and the two inbred parents furnishes some evidence as to phenotypic dominance relations for parts per million of NO_3-N in the petioles. The mean of the two inbreds (see table 1) is 2039. The mean 2172 of the F_1 hybrid is not significantly different from 2039. Dominance is not complete and there is no heterosis. The true relation may be either partial or intermediate phenotypic dominance.

The weight per root for the F_1 hybrid is approximately twice as great as that of either parent. Heterosis for weight per root was expected.

First Order Interactions

The means for percentage sucrose, parts per million of NO_3-N in the petioles, and weight per root for the interaction of replications X populations are listed in table 2. Analyses of variance not presented here revealed that the interaction of replications X populations was not significant at the 5% level for either percentage sucrose or weight per root.

Table 2. Means of percentage sucrose, parts per million NO_3-N in the petioles, and weight per root for the interaction of replications X populations.

Population and treatment	Replications combined				
	1-8	9-16	17-24	25-32	33-40
A54-1					
Sucrose, %	17.6	18.0	18.0	17.5	15.6
NO_3-N, ppm	1198	901	734	2174	9916
Weight, lbs.	2.42	2.10	2.01	2.23	2.56
A54-1 BB					
Sucrose, %	17.4	18.4	18.1	16.8	15.8
NO_3-N, ppm	1002	928	983	3097	10182
Weight, lbs.	2.34	2.04	1.99	2.14	2.37
50-406 BB					
Sucrose, %	17.5	18.0	18.0	17.4	16.2
NO_3-N, ppm	991	728	956	1612	10108
Weight, lbs.	1.76	1.84	1.64	1.58	1.77
50-406					
Sucrose, %	17.4	17.3	17.2	16.4	15.6
NO_3-N, ppm	616	494	496	663	5880
Weight, lbs.	0.95	0.85	0.83	0.88	0.92
F_1 hybrid					
Sucrose, %	17.9	18.4	18.0	17.3	16.4
NO_3-N, ppm	543	382	586	1240	8109
Weight, lbs.	1.94	1.94	1.70	1.85	1.99
52-307					
Sucrose, %	16.2	17.4	17.1	16.9	15.2
NO_3-N, ppm	558	484	620	1322	9259
Weight, lbs.	0.90	0.82	0.76	0.88	1.00

This did not hold for NO_3-N as this interaction for parts per million of NO_3-N in the petioles was significant at the 5% level. In other words, all varieties were not behaving the same for all replications in respect to the amount of NO_3-N in the petioles. The inbred 50-406 seems to be responding differently from the other populations to replication groups 25-32 and 33-40. This is most clearly evidenced in comparing populations 50-406, the F_1 hybrid, and 52-307. Inbred 50-406 does not differ materially from the F_1 hybrid and 52-307 in groups 1-8, 9-16, and 17-24, but is lower in parts per million of NO_3-N in the petioles for groups 25-32 and 33-40. This differential behavior between populations may have considerable importance in breeding varieties adapted to production at different levels of soil fertility.

The means of these three characters for the interaction of replications X treatments are listed in table 3. This interaction is highly significant for all three characters. For the first three replication groups the two fertilizer treatments do not differ greatly in percentage sucrose, but they do differ materially in the last two replication groups. For NO_3-N there is a decided increase in replication group 25-32 on the fertilized plots, whereas such is not the case for the non-fertilized plots. For weight per root on the non-fertilized plots there is a decided increase in replication group 33-40 over all other groups, but on the fertilized plots the 33-40 group does not differ appreciably from the others.

Table 3. Means of percentage sucrose, parts per million NO_3-N in the petioles, and weight per root for the interaction of replications X treatments.

Treatment	Replications combined				
	1-8	9-16	17-24	25-32	33-40
Fertilized					
Sucrose, %	17.2	17.8	17.7	16.5	15.0
NO_3-N, ppm	1139	846	933	2699	13039
Weight, lbs.	2.08	2.02	1.88	1.84	1.93
Non-fertilized					
Sucrose, %	17.4	18.1	17.8	17.6	16.5
NO_3-N, ppm	497	460	526	670	4779
Weight, lbs.	1.36	1.18	1.10	1.35	1.61

These findings have a very practical application to the production of sugar beets and the processing of sugar from beets. It seems that the percentage sucrose is not greatly reduced in the root when the parts per million of NO_3-N in the petioles is less than 1000 but is reduced when that amount is exceeded appreciably. This finding agrees with those of Ulrich. On the fertilized plots an increase of NO_3-N in the petioles above 1139 did not result in an increase in weight per root. Further, group 33-40 on the non-fertilized plots with 4779 parts per million of NO_3-N did not have as great a weight per root as did the first three replication groups of the fertilized plots which had less than 1200 parts per million of NO_3-N in the petioles. This type of interaction may have been due to a deficiency of P_2O_5 on the non-fertilized plots.

The means for the interaction of populations X treatments are listed in table 4. This first order interaction is significant at the 1% level for percentage sucrose and weight per root and at the 5% level for parts per million of NO_3-N in the petioles. It is particularly interesting for percentage sucrose. Populations A54-1, A54-1 BB and 50-406 on the fertilized plots have materially lower percentage sucrose than they do on the non-fertilized plots. There is no material reduction in percentage sucrose of the fertilized plots as compared with non-fertilized plots for populations 50-406 BB, F_1 hybrid, and 52-307. This is particularly true of the last two populations, F_1 and 52-307. The F_1 shows decided heterosis for percentage sucrose on the fertilized plots whereas on the non-fertilized plots the F_1 hybrid is not significantly higher in percentage sucrose than the inbred parent 50-406.

Table 4. Means of percentage sucrose, parts per million NO_3-N in the petioles, and weight per root for the interaction of populations X treatments.

Treatment and character	A54-1	A54-1 BB	50-406 BB	50-406	F_1 hybrid	52-307
Fertilized						
Sucrose, %	16.8	16.7	17.3	16.1	17.6	16.6
NO_3-N, ppm	4233	4885	4267	2297	3060	3645
Weight, lbs.	2.60	2.64	2.04	1.02	2.23	1.16
Non-fertilized						
Sucrose, %	17.9	17.9	17.6	17.4	17.6	16.5
NO_3-N, ppm	1736	1592	1491	962	1284	1252
Weight, lbs.	1.93	1.71	1.40	0.75	1.54	0.58

The first order interaction of populations X treatments for NO_3-N is illustrated by the difference between populations A54-1 BB and 50-406 for the two treatments. The difference for A54-1 BB is 3293 and for 50-406 is 1335. Also a comparison involving these same two populations illustrates the interaction for weight per root. The difference involving A54-1 BB is 0.93 pounds per root and that involving 50-406 is 0.27 pounds per root.

Second Order Interaction

The means for percentage sucrose, parts per million of NO_3-N in the petioles, and weight per root for the interaction of replications X populations X treatments are listed in table 5. This interaction is significant at the 1% level for percentage sucrose and weight per root. The method of collecting the data on the basis of groups of four replications instead of individual plants did not provide for testing the significance of this second order interaction for parts per million of NO_3-N in the petioles by the analysis of variance and Snedecor's F test. However, as shown previously the first order interactions of replications X treatments and populations X treatments were significant at the 1% and 5% levels, respectively.

Table 5. Means of percentage sucrose, parts per million NO_3-N in the petioles, and weight per root for the interaction of replications X populations X treatments.

Population and character	Fertilized					Non-fertilized				
	Replications combined					Replications combined				
	1-8	9-16	17-24	25-32	33-40	1-8	9-16	17-24	25-32	33-40
A54-1										
Sucrose, %	17.1	17.6	17.7	16.8	14.6	18.0	18.4	18.3	18.2	16.6
NO_3-N, ppm	1724	1350	829	3484	13778	671	452	640	864	6055
Weight, lbs.	2.90	2.55	2.41	2.44	2.69	1.93	1.66	1.61	2.02	2.43
A54-1 BB										
Sucrose, %	16.9	18.2	17.9	16.2	14.5	17.8	18.7	18.3	17.5	17.0
NO_3-N, ppm	1505	1154	1264	5368	15132	499	702	702	826	5231
Weight, lbs.	2.85	2.57	2.51	2.66	2.61	1.82	1.51	1.47	1.62	2.13
50-406 BB										
Sucrose, %	17.6	18.1	18.1	17.0	15.5	17.4	18.0	17.9	17.7	16.8
NO_3-N, ppm	1482	1050	1357	2656	14791	500	406	554	569	5426
Weight, lbs.	2.09	2.24	2.07	1.82	1.96	1.44	1.43	1.20	1.35	1.58
50-406										
Sucrose, %	16.8	16.8	16.6	15.6	14.7	17.9	17.8	17.7	17.3	16.4
NO_3-N, ppm	702	551	632	788	8812	530	436	359	538	2948
Weight, lbs.	1.11	1.09	0.98	0.96	0.98	0.79	0.61	0.68	0.79	0.87
F_1 hybrid										
Sucrose, %	18.2	18.5	18.2	17.0	16.0	17.6	18.3	17.7	17.6	16.8
NO_3-N, ppm	852	390	648	2082	11328	234	374	524	398	4890
Weight, lbs.	2.29	2.49	2.19	2.03	2.16	1.60	1.39	1.20	1.67	1.82
52-307										
Sucrose, %	16.6	17.4	17.6	16.4	14.9	15.7	17.3	16.6	17.4	15.6
NO_3-N, ppm	570	578	866	1817	14392	546	390	374	826	4126
Weight, lbs.	1.21	1.18	1.10	1.10	1.19	0.58	0.45	0.41	0.67	0.81

A study of table 5 reveals that for all five replication groups the percentage sucrose of the F_1 exceeds that of A54-1 on the fertilized plots while the reverse is true (excepting the 33-40 group) on the non-fertilized plots. For the first three replications groups 50-406 BB, the F_1 hybrid, and 52-307 all show an increase in percentage sucrose on the fertilized plots as compared with the non-fertilized plots, whereas the reverse is true for populations A54-1, A54-1 BB, and 50-406.

The parts per million of NO_3-N in the petioles involving the above comparisons are of interest. On the non-fertilized plots A54-1 has an average of 588 parts per million of NO_3-N in the petioles for the first three groups and the average percent sucrose is 18.2. Considering the F_1 the same values for the first three groups on the fertilized plots are 630, and 18.3. Apparently the F_1 hybrid and A54-1 have the same optimum ~~amount of~~ concentration of nitrate nitrogen in the petioles for maximum percentage sucrose in the roots. However, the F_1 reaches this optimum at the high fertility level, whereas A54-1 reaches approximately this same concentration of NO_3-N at the lower fertility level. It seems that either A54-1 is more efficient in taking up NO_3-N at the lower fertility and retaining it in the petioles, or at the higher fertility the F_1 uses up more nitrogen in metabolism or does not retain it in the petioles. This difference in reaction of populations may have a decided bearing on programs for breeding populations of sugar beets better adapted to sugar production at higher fertility levels.

Another comparison involving 50-406 BB with A54-1 BB and A54-1 for the first three groups and the fertilized and non-fertilized treatments is of interest. For 50-406 BB an average increase in NO_3-N in the petioles from 486 parts per million on the first three replication groups of the non-fertilized plots to 1296 on the first three replication groups of the fertilized plots was not accompanied by a decrease in percentage sucrose (17.8 to 17.9). For A54-1 BB and A54-1 the corresponding values are 634 to 1308 and 18.3 to 17.7, and 588 to 1301 and 18.2 to 17.5. These results are rather convincing evidence that certain populations may be able to tolerate more NO_3-N in the petioles than others without an accompanying reduction in percentage sucrose.

Also the second order interaction of replications X populations X treatments is of interest in connection with information it furnishes concerning the nature of heterosis in this F_1. Both the F_1 hybrid and the inbred parent 52-307 on the fertilized plots produced a higher percentage sucrose for the first three replication groups than they did on these same replication groups on the non-fertilized plots. The reverse is true for 50-406 for the same replication groups. The percentage sucrose for both the F_1 hybrid and 52-307 is less on the fertilized plots than it is on the non-fertilized plots for the last two replication groups but still higher than that of 50-406. Thus the behavior pattern for the F_1 and 52-307 is the same, as regards the ability to produce higher percentage sucrose than 50-406 at the higher level of soil fertility. Hence this ability to produce higher percentage sucrose at the higher fertility level is partially or completely dominant. On the

other hand, the 50-406 inbred as shown by a comparison of the non-fertilized plots of 50-406 and 52-307 is potentially the higher percentage sucrose parent. This potential of 50-406 to produce a high percentage sucrose is at least partially if not completely dominant in the F_1 hybrid. Hence the ability of the F_1 hybrid to react as the inbred parent 50-406 in respect to high potential percentage sucrose production and as the 52-307 parent in being able to maintain percentage sucrose on the higher fertility level results in the heterosis noted for the F_1 on the high fertility plots.

Further study of table 5 reveals that the behavior pattern of 50-406 BB as compared with 50-406 on the fertilized and non-fertilized plots is very similar to that of the F_1 and 50-406 involving the same comparisons. The populations 50-406 and 50-406 BB differ from each other in that the seed which produced the plants of 50-406 BB came from mother beets which at the time of flowering were exposed to pollen from 22 other varieties, strains, or inbreds; whereas the mother beets producing 50-406 were not exposed to other pollen than their own. These latter results are important because they lend indirect support to the finding that heterosis does occur for higher percentage sucrose and indicates that it may not be of too rare occurrence in sugar beets.

[illegible]d, the 50-406 inbred as shown by a comparison of the non-fertilized [illegible] 50-406 and 52-307 is potentially the higher percentage sucrose parent. The [illegible]ntial of 50-405 to produce a high percentage sucrose is at least [illegible] if not completely dominant in the F_1 hybrid. Hence the ability of [illegible] F_1 hybrid to react as the inbred parent 50-406 in respect to high potential [illegible] production and as the 52-307 parent in being able to main-[illegible] sucrose on the higher fertility level results in the heterosis [illegible] the F_1 on the high fertility plots.

[illegible] study of table 5 reveals that the behavior pattern of 50-406 BS [illegible]red with [illegible]-406 on the fertilized and non-fertilized plots is very [illegible] that of the F_1 and 50-406 involving the same comparisons. The [illegible] 50-406 and 50-406 BS differ from each other in that the seed which [illegible] plants of 50-406 BS came from mother beets which at the time of [illegible]g were exposed to pollen from 22 other varieties, strains, or inbreds, [illegible] mother beets producing 50-406 were not exposed to other pollen [illegible]. These latter results are important because they lend indirect [illegible] to the finding that heterosis does occur for higher percentage sucrose [illegible]ates that it may not be of too rare occurrence in sugar beets.

Parts per 100,000 of Sodium and Potassium

Mean parts per 100,000 of sodium and potassium for population X treatment combinations are shown in table 6.

Table 6. Mean parts per 100,000 of sodium and potassium for population X treatment combinations.

Treatment	Population					
	A54-1	A54-1 BB	50-406 BB	50-406	F_1	52-307
Sodium						
Fertilized	47.87	49.58	31.50	33.44	33.45	43.38
Non-fertilized	26.98	25.04	19.46	17.64	19.87	25.85
Potassium						
Fertilized	133.12	129.72	112.54	122.62	101.87	99.38
Non-fertilized	122.61	114.43	99.34	103.78	96.00	106.76

It can be seen from table 6 that the populations contained nearly twice as much sodium when grown on the fertilized plots instead of the non-fertilized plots. The F_1 hybrid between inbreds 50-406 and 52-307 showed complete dominance for low sodium at the higher nitrogen level and at least partial dominance for low sodium at the lower nitrogen level. These data indicate that low sodium hybrids could be produced if they were desired.

All populations studied except inbred 52-307 were significantly higher in potassium on the fertilized plots. 52-307 had significantly less potassium in the roots on the fertilized plots than on the non-fertilized plots. This population X treatment interaction leads to an interesting result in that the F_1 hybrid showed complete dominance for low potassium on the fertilized

treatment and heterosis (F_1 significantly lower than the low parent) for low potassium on the non-fertilized treatment. On the high nitrogen plots 50-406 is significantly higher in potassium than 52-307, while on the low nitrogen plots 50-406 and 52-307 are not significantly different in potassium content. These results indicate that the nitrogen level of the soil must be considered if the breeder is selecting for either low or high potassium.

Polyploid Phase of the Breeding Program

The objectives of the polyploid program at Fort Collins are to study the effects of triploidy and tetraploidy on percentage sucrose and other economic characters of sugar beets and to develop and evaluate techniques and methods for breeding polyploid sugar beets.

In 1957 the number of chloroplasts per pair of guard cells was studied as a possible indicator of ploidy level. It was found that diploid and tetraploid plants could be readily separated by counting the number of chloroplasts per guard cell or pair of guard cells. The average number of chloroplasts per pair of guard cells was found to be 13.2 for the diploids studied (7 inbred lines and one F_1 hybrid) and 23.7 for 8 tetraploid inbreds (see table 7).

Table 7. Means and standard errors[1,2] for number of chloroplasts per pair of guard cells of certain tetraploids and diploids.

Tetraploids		Diploids	
Entry	Mean number chloroplasts	Entry	Mean number chloroplasts
52-430-1	22.8	573-1	14.0
" " -2	24.1	574-1	11.8
" " -3	23.3	575-1	13.6
" " -4	22.9	576-1	12.9
" " -5	23.3	577-1	12.1
" " -6	24.7	578-1	13.2
52-307	23.2	579-1	13.3
50-406	25.3	5711-1	14.4
Grand mean	23.7	Grand mean	13.2

1. Standard error of an entry mean = 0.4423.

2. Standard error of a grand mean = 0.1564.

The technique of counting chloroplasts consists of peeling off a thin piece of epidermis from the back side of any mature leaf on the plant, mounting the speciman in a drop of tap water, and examining the slide under 430x or 970x magnification. Using this method a trained worker and an assistant (who can be taught to make the slides in a few minutes) can examine 200 plants per day. The technique is very useful for screening colchicine treated seedlings to eliminate unaffected plants. The above results and technique have been submitted for publication.

The technique can also be used to determine the percentage of diploids, triploids, and tetraploids in a mixed population. A sample of 100 seedlings from a population of Polybeta was examined by counting the chloroplasts in the guard cells of cotyledonary leaves. The frequency distribution obtained for

a sample of 30 pairs of guard cells per plant is shown in table 8. One distinct break was obtained at class 17-19 and another at class 23. These breaks occur at approximately the points that would be expected to separate diploids from triploids and triploids from tetraploids. The percentages of supposed diploids, triploids, and tetraploids obtained were 7, 42, and 51 percent, respectively. This compares with percentages of 15, 45, and 40 which have been reported by European workers for this variety.

Table 8. Frequency distribution for mean number of chloroplasts per pair of guard cells found in a population of Polybeta compared with distributions of known diploids and tetraploids.

Population	Number of plants having chloroplast counts of:						
	14	15-16	17-19	20-22	23	24	25-28
	Diploid*		Triploid*			Tetraploid*	
Polybeta	1	6		42		2	49
Known diploids	7	1					
Known tetraploids					2	3	3

* = Supposedly

During 1957, C_2 roots of the tetraploid phase of three inbreds doubled by Klitgaard were obtained. Putative tetraploid C_o plants of one other inbred line were obtained by colchicine treatment. These inbreds, along with other inbred lines which are being treated with colchicine at the present time, will be used in the study of heterosis at the diploid, triploid, and tetraploid levels. Other material which is being treated with colchicine to obtain tetraploid equivalents includes: (1) F_1 hybrids which will be used in synthetic varieties to be compared at the diploid and tetraploid levels; and (2) a broad base cytoplasmic male sterile population to be used in the study of the effect of polyploidy on male sterility and in a study of breeding methods for development of superior polyploid varieties.

PROGRESS REPORT TO THE BEET SUGAR DEVELOPMENT FOUNDATION ON RHIZOCTONIA RESISTANCE BREEDING INVESTIGATIONS, FORT COLLINS, COLORADO, 1957 1/

(A Phase of Foundation Project No. 25)

John O. Gaskill and Victor G. Pierson 2/

In the work conducted during 1957, continued emphasis was given to the subject of techniques for exposure of sugar beets to Rhizoctonia attack. These studies included methods of preparation of inoculum, time and dosage trials, and comparison of a selected set of 24 sugar beet strains for resistance under field conditions.

In the 1956 report to the Foundation, results obtained from the application of barley-type Rhizoctonia inoculum with the seed were discussed. In 1957, it was observed that sterile barley applied with the seed in field plots resulted in severe killing of young plants, largely before emergence. Subsequent laboratory trials indicated that the presence of the barley promoted attack of the seedlings by pathogenic organisms -- principally Pythium sp. — occurring naturally in the field soil. These observations cast some doubt on the validity of barley-type Rhizoctonia inoculum, applied with the seed, as a means of creating exposure to that pathogen, and spurred the search for other inoculation methods. Except for one technique discussed in succeeding paragraphs, this line of study has not progressed sufficiently to justify a report at this time.

The most interesting and encouraging results obtained in 1957 came from a field trial on the Hospital Farm at Ft. Collins, designated "Experiment R-2." Twenty-four sugar beet strains or varieties were chosen for this study, representing a wide range of types and including material which had resulted from selection for resistance to three root diseases of fungus origin. Several sugar companies cooperated by furnishing seed developed by their breeding departments. The experiment was begun with a split-plot design, two methods of inoculation plus check (non-inoculated), and three replications; total of 216 sub-plots, each 1 row x 15 ft., net. Planting was done on July 5. Inoculation method no. 1 (ground, barley-type, Rhizoctonia inoculum applied with the seed) resulted in almost complete kill of all 24 strains — largely before emergence -- and the results were not analyzed statistically and are not presented in this report. The second method of inoculation was employed on August 2 -- 4 to 7 days after thinning. The soil around each plant was removed by hand to a depth of approximately 1 to 1-1/4 inches; 2 ml. of the above inoculum was applied as a band around and in contact with the tap root, and the soil was replaced. So-called

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1/ Cooperative research conducted by the Sugar Beet Section, Crops Research Division, A.R.S., U.S.D.A., and the Botany and Plant Pathology Section, Colo. Agr. Exp. Station, supported in part by funds contributed by the Beet Sugar Development Foundation and the Great Western Sugar Company.

2/ Plant Pathologist, U.S.D.A., and Graduate Research Assistant, Colo. Agr. Exp. Station, respectively. Acknowledgment is made of active participation, during the early part of the 1957 program and in prior years, by Norman R. Gerhold and Kenneth E. Mueller, formerly Associate Plant Pathologist and Junior Plant Pathologist, respectively, Colo. Agr. Exp. Station.

Rhizoctonia Investigations, continued

"dummy inoculum" (sterilized barley, without Rhizoctonia) was applied in a similar manner to one-half of each of the check sub-plots. Immediately after completion of the inoculation job, the entire field was sprinkled artificially — enough to moisten the buried inoculum thoroughly — and about 1 inch of rain fell during the following 24 hours.

The plants in check rows grew normally, and the effect of the dummy inoculum appeared to be negligible. In the inoculated rows, substantial dying of plants was observed as early as August 13, 11 days after inoculation. Dying continued to occur at a relatively rapid pace until about the middle of September. Originally it was planned to base conclusions on plant counts only. However, the wide range of disease reaction among plants still living at harvest, within individual sub-plots, led to the conclusion that harvest weights would yield more reliable information. All living plants in each sub-plot were trimmed as mother beets, washed, and weighed. Those deemed suitable for breeding purposes subsequently were placed in storage.

The results of this experiment are illustrated in Figures 3, 4, and 5, and presented in some detail in Table 1. The wide range in disease reaction of the different sugar beet strains, as shown in the "% of check" column for root yield, is of special interest. As indicated by the F-value in that column, highly significant differences occurred among the 24 strains.

In the special comparisons of harvest results presented in Table 2, two trends stand out:

1. The 3 Rhizoctonia resistant selections furnished by the Great Western Sugar Company, as a class, were significantly higher in root yield, under Rhizoctonia exposure, than the parental material — on both percentage and actual-weight basis (section A of table). As shown by the comparable check averages, this occurrence cannot be attributed to differing yielding abilities of the 2 classes, per se.

2. The highly significant differences presented in sections B and C indicate that, in the material studied, resistance to Rhizoctonia solani tends to be associated with resistance to the black-root fungus, Aphanomyces cochlioides. On the basis of the check averages in section C, differences in simple yielding ability may be disregarded as a possible cause of this apparent trend.

Although the results of this experiment should not be considered as proof of the value of the post-thinning inoculation method described, they do indicate rather strongly: (1) that an appreciable degree of Rhizoctonia resistance occurs in the sugar beet, and (2) that some measure of success reasonably could be expected by utilization of this inoculation technique for selection and progeny testing purposes.

RHIZOCTONIA INOCULATION. FORT COLLINS, COLORADO, 1957

Figure 3. Experiment R-2, Ft. Collins, 9/23/57, 52 days after post-thinning inoculation with Rhizoctonia: Left, 24 non-inoculated sub-plots; Right, a comparable series of inoculated sub-plots.

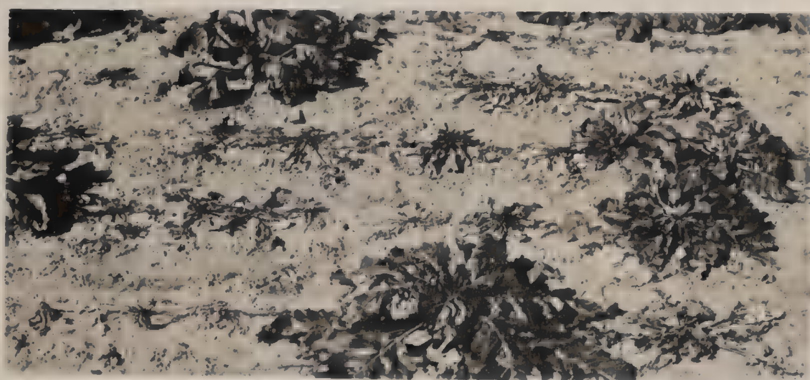

Figure 4. Close-up of an inoculated area in the above experiment, 9/23/57, 52 days after post-thinning inoculation.

Figure 5. Roots from Acc. 1353 (code 5) in the above experiment, 10/17/57: The healthy root at left was representative of the population (24 plants) in a check sub-plot; and the other 9 roots constituted the entire living population of a comparable inoculated sub-plot, with typical symptoms of Rhizoctonia attack, as observed in this experiment, ranging from mild deformity to severe stunting and necrosis.

Table 1. — Experiment R-2, 1957, Hospital Farm, Ft. Collins, Colo.: Comparison of sugar beet strains for Rhizoctonia resistance; results given as 3-plot averages.

Strain (Code no.)	F.C. acc. no.	Description	Class.[a] B.R. res.	Class.[a] Rhiz. res.	Living plants per 100' Post-thin. (7-30-57) Ck.[c]	Post-thin. (7-30-57) Inoc.	Pre-harvest (10-15-57) Ck.[c]	Pre-harvest (10-15-57) Inoc.	Rt. yield per plot[b] Ck.[c] Act.	Inoculated Act.	Inoculated % of Ck.[d]
					No.	No.	No.	No.	Lb.	Lb.	
1	2156	GW 304R	-	-	156	142	149	31	16.20	2.77	16.8
2	2057	WC 5354; US 401	+	-	144	136	136	27	15.00	3.40	22.0
3	2069	GW 359-53R	-	-	133	151	118	31	13.03	4.33	32.8
4	2159	Amer. 5	-	-	156	147	140	42	14.93	4.00	29.9
5	1353	WC 4216; SP 52108-0	+	-	158	153	151	53	14.47	6.87	47.9
6	1366	SP 55112-01	+	-	162	164	151	60	12.70	5.87	47.5
7	2155	GW 529	-	-	162	149	140	38	13.63	4.77	34.5
8	2072	Amer. 3-S; 50-804	+	-	133	144	122	40	11.10	4.13	37.9
9	2056	WC 4441; US 400	+	-	158	153	140	38	13.90	4.93	37.0
10	2157	GW 526; recon. approx. of parent of 13	-	-	147	158	138	20	13.00	1.73	14.3
11	2015	C 368; US 75	-	-	151	169	147	40	13.70	2.80	21.2
12	2067	WC 5215; SP 5460-0	+	-	149	140	140	42	13.00	3.60	27.1
13	2154	B 525-50L (G.W.S.Co.); Rhiz.res.sel.(see 10)	-	+	147	142	138	42	13.23	5.60	42.8
14	1358	WC 9323;SP 471001-0; inb.; v. sus. to B.R.	-	-	98	118	93	13	6.87	0.80	9.2
15	2158	56-202(A.C.S.Co.); Sclerotium res. sel.fr. 4	-	-	151	140	142	27	13.53	2.93	23.5
16	2064	WC 5212; SP 5480-0	+	-	156	162	153	42	14.77	3.77	25.4
17	2066	WC 5214; SP 5481-0	+	-	138	127	133	31	13.30	4.53	33.7
18	1375	WC 6305; U-I E/1; monogerm hyb.	-	-	149	147	142	27	13.80	2.23	16.2
19	2152	B 579 (G.W.S. Co.); Rhiz. res. sel. fr. 1	-	+	144	164	136	53	13.47	6.43	47.6
20	1208	Klein E	-	-	142	149	140	13	15.83	0.83	5.0
21	2013	WC 3321; US 201-B; inbred	-	-	131	167	116	36	8.50	3.40	40.4
22	2153	B 590 (G.W.S.Co.); Rhiz. res. sel. fr. 7	-	+	140	149	131	44	14.33	6.80	48.0
23	1334	MW 391 (H.S. Corp.)	-	-	162	151	153	31	15.57	2.83	18.2
24	2071	Amer. 1; 45-414-X	-	-	140	147	133	20	13.03	1.63	12.5
General mean					146.1	148.7	136.8	35.0	13.37	3.79	28.81
Calculated F for strains											2.29**
LSD (5% point)											24.7

** F-value equal to or greater than 1% point.

a/ Classification: "+" indicates strain had resulted from selection for resistance to the disease shown — "B.R." = black root (Aphanomyces cochlioides), and "Rhiz." = Rhizoctonia root rot (Rhizoctonia solani).

b/ Total weight of roots of living plants at harvest, 10/15-17/57 (crown included); plots 1 row x 15 ft.

c/ Check = non-inoculated.

d/ Each value given in the "% of check" column is an average of 3 percentage determinations, each of which represented the root yield of one inoculated sub-plot expressed as a percentage of the root yield of the corresponding non-inoculated sub-plot.

Table 2.--Experiment R-2, 1957, Hospital Farm, Ft. Collins, Colo.: special comparisons for Rhizoctonia resistance[a]

Description of material compared	Root yield per plot		
	Check[b]	Inoculated	
	Act.wt.	Act.wt.	% of ck.
	Lb.	Lb.	
A. Comparison of G.W.S. Co. Rhizoctonia resistant selections with parental material:			
Parents (codes 1,7,10)	14.28	3.09	21.87
Selections (codes 13,19,22)	13.68	6.28	46.13
Difference	0.60	3.19*	24.26**
B. Comparison on %-of-check basis — all strains classed as black-root resistant *vs.* all other strains, excluding the 3 resulting from selection for *Rhizoctonia* resistance (codes 13, 19,22):			
Black-root resistant selections (codes 2,5, 6,8,9,12,16,17)			34.81
Other (codes 1,3,4,7,10,11,14,15,18,20,21, 23,24)			21.12
Difference			13.69**
C. Comparison on actual-weight basis — same material as in B, except for deletion of the only 2 inbreds in the experiment (codes 14,21):			
Black-root resistant selections	13.53	4.64	
Other	14.21	2.81	
Difference	0.68	1.83**	

* Significant difference (equal to or greater than 5% point)

** Highly significant difference (equal to or greater than 1% point)

a/ See table 1 for basic data

b/ Check = non-inoculated

P A R T VII

DEVELOPMENT AND EVALUATION OF VARIETIES OF SUGAR BEETS SUITABLE FOR THE GREAT LAKES REGION

with emphasis on

Black Root and Leaf Spot Resistance

Supported under Foundation Project 26

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Farmers and Manufacturers Beet Sugar Association
Great Western Sugar Company

Development and Evaluation of Varieties of Sugar Beets Suitable for the Great Lakes Region

Introduction

by Dewey Stewart

Agronomic evaluation tests were conducted in 1957 with US 401 and six synthetic varieties that were developed in the program of breeding for resistance to leaf spot and black root and with two monogerm hybrids in which the pollinators that were used to bring about the hybridizations were resistant to leaf spot and to black root. Tests were conducted in the States of Michigan, Ohio, Wisconsin, and Minnesota, and in Ontario, Canada.

Members of the Sugar Beet Section who conducted tests are H. W. Bockstahler and G. J. Hogaboam, in Michigan and Ohio; H. L. Bissonnette, in Minnesota. Tests were conducted by P. A. Reeve and M. R. Berrett, Farmers and Manufacturers Beet Sugar Association, at Sebewaing, Croswell, and Merrill, Michigan; at Bay City, Michigan, in cooperation with Grant Nichol, Monitor Sugar Division; at Chilton, Wisconsin, in cooperation with E. G. Minielly, Menominee Sugar Company; and at Wallaceburg and Kippen, Ontario, with the cooperation of the Canada and Dominion Sugar Company. Two tests were conducted in Ohio by H. E. Brewbaker and H. L. Bush of the Great Western Sugar Company. In all, there were 13 tests with 9 entries, including US 401 as Accession 1395. The results of these tests have been given in Summary Tables 1, 2, and 3.

Leaf spot was reported as moderate in the tests at Fremont and Pandora, Ohio, and at Saginaw, Michigan. In the other tests, this disease was light or a negligible factor in the growth of the plants. Black root was reported as severe in the tests at East Lansing, Michigan, but in all other tests this disease was not a factor in the relative performances of the varieties. In general it can be said that except for the tests at East Lansing, where black root was severe, disease was not a serious influence in the relative performances of the varieties and hybrids included in these tests conducted in the humid region.

The outstanding average performance in gross sugar per acre was given by SP 5481-0, SP 5510-0, and SP 5511-0--the latter two varieties being synthesized by pooling selfed progenies of mothers giving polycross hybrids of superior performances under leaf spot and black root exposure at Beltsville, Maryland, East Lansing, Michigan, and Waseca, Minnesota.

In acre yield of roots based on average values, as given in Summary Table 2, US 401 is highest among the 9 entries. It should be noted that in the field tests conducted at East Lansing, Michigan, where black root was severe, and at Merrill and Saginaw, Michigan, where black root was light, the monogerm hybrids, Acc. 1396 and Acc. 1397, gave relatively low yield of roots. Only the pollen parent of these

monogerm hybrids had been selected for black root resistance. In the other tests where black root was negligible, the acre yield of roots of these monogerm hybrids was not disappointing. Unfortunately, the difficulties encountered in the stock seed of the male-sterile monogerm parents render unlikely that further consideration will be given to their utilization in commercial hybrid combinations.

Sucrose percentages given as average in Summary Table 3 show, in general, higher values for the new synthetics than for US 401. The highest average sucrose percentage was given by SP 53AB1-0, a breeder seed produced by H. W. Bockstahler and G. J. Hogaboam at East Lansing, Michigan. This entry is followed by the synthetics SP 5460-0, SP 5511-0, and SP 5512-0. As mentioned on page 112 of the 1956 Report, SP 5460-0 has given outstanding sucrose percentage on the Plant Industry Station when grown under severe exposure to leaf spot and black root.

Agronomic Evaluation Tests
Humid Region
1957

Seed No.	Description
1. Acc. 1378	WC 6200, increase of SP 5510-0, leaf spot and black root resistant synthetic variety from mothers outstanding in polycross progeny test.
2. SP 5611-0	Leaf spot and black root resistant synthetic variety from mothers outstanding in polycross progeny test.
3. Acc. 1379	WC 6201, increase of SP 5512-0, leaf spot and black root resistant synthetic variety from mothers outstanding in polycross progeny test.
4. Acc. 1380	WC 6327, increase of WC 5215, from SP 5460-0, leaf spot and black root resistant variety from polycross progeny SP 53AB1-65.
5. Acc. 1382	WC 6319, increase of WC 5214 from SP 5481-0, leaf spot and black root resistant variety from the outstanding progenies of SP 53AB1-polycrosses.
6. Acc. 1394	WC 6315, increase of SP 53AB1-0, leaf spot and black root resistant variety related to Acc. 1382
7. Acc. 1395	WC 6302. US 401.
*8. Acc. 1396	WC 6203F. Monogerm hybrid, 50% of mixture. SP 5515-01ms X SP 5460-0 WC 6206F. Monogerm hybrid, 50% of mixture. SP 5515-01ms X US 401
*9. Acc. 1397	WC 6204F. Monogerm hybrid, 50% of mixture. SP 5520-01ms X SP 5460-0 WC 6207F. Monogerm hybrid, 50% of mixture. SP 5520-01ms X US 401

*All seed numbers are known to have good germination except the monogerm hybrids, Acc. 1396 and Acc. 1397. If tests under way indicate viability too low for use, related hybrids will be substituted, as follows:

SP 5621-0. SP 5515-01ms X black root resistant varieties, for Acc. 1396
SP 5626-0. SP 5520-01ms X black root resistant varieties, for Acc. 1397

SP 5621-0 and SP 5626-0 have germination of 60% and 65%, respectively.

Summary Table 1.--Acre-yield of gross sugar in agronomic tests conducted in the Great Lakes area in 1957 to evaluate US 401 and related varieties of sugar beets developed for the humid region. Data are given as 6-plot averages, except as noted.1/

Grower and Location	Reported by	SP 5510-0 Acc. 1378	SP 5511-0 SP 5611-0	SP 5512-0 Acc. 1379	SP 5460-0 Acc. 1380	SP 5481-0 Acc. 1382	SP 53AB1-0 Acc. 1394	US 401 Acc. 1395	Monogerm SP 5515-01? Acc. 1396	Monogerm SP 5520-01? Acc. 1397	LSD Odds 19:1
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Gremel, H. Sebewaing, Mich.	Reeve Berrett	8153	8196	7994	8143	8632	8220	7339	8159	7717	N.S.
Rader, E. Saginaw, Mich.1/	Reeve Berrett	6165	5613	5423	5288	5823	5367	5897	5642	5742	596
Gordon, R. Croswell, Mich.	Reeve Berrett	6723	6259	6104	5947	6076	5958	6207	6771	5957	602
Detroit Stake Merrill, Mich.	Reeve Berrett	3880	3793	3585	3482	3765	4120	4051	3635	3053	561
Schultz, W. Bay City, Mich.	Reeve Nichol	5837	6333	6139	6058	6249	6265	5855	5940	5904	N.S.
U.S.D.A. East Lansing, Mich.	Bockstahler Hogaboam	3888	4204	4585	4008	4268	4490	4053	3571	3817	595
Risser, L. Pandora, Ohio	Bockstahler Hogaboam	8570	8443	8788	8899	9251	8573	8156	8255	9126	972
Haas, G. Fremont, Ohio	Brewbaker Bush	4263	4402	4025	4095	4497	4288	4248	4072	4514	397
Krause, E. & K. Findlay, Ohio	Brewbaker Bush	5510	5556	5170	4926	4986	5463	5625	5315	5421	489
Paulson Farm Chilton, Wisc.	Reeve Minielly	4997	4936	4485	4568	4748	4944	4640	4877	4615	N.S.
Ottinger, T. Chaska, Minn.	Bissonnette	4504	4034	3432	3752	4342	3944	4459	3977	3704	659
C. & D. Sugar Co. Wallaceburg, Ont.	Broadwell	6643	7020	6826	6785	6692	6176	6511	6969	6503	N.S.
Lovell, L. Kippen, Ont.	Broadwell	5790	5903	5268	5311	5537	5732	5022	5992	5982	N.S.
Mean of 13 tests in humid region		5763	5746	5525	5482	5759	5657	5613	5629	5543	
US 401 as 100%		102.7	102.4	98.4	97.7	102.6	100.8	100.0	100.3	98.8	

1/ Results of test at Saginaw are reported as 5-plot averages.

Summary Table 2.--Acre-yield of roots in agronomic tests conducted in the Great Lakes area in 1957 to evaluate US 401 and related varieties of sugar beets developed for the humid region. Data are given as 6-plot averages, except as noted.1/

Grower and Location	Reported by	SP 5510-0 Acc. 1378	SP 5511-0 SP 5611-0	SP 5512-0 Acc. 1379	SP 5460-0 Acc. 1380	SP 5481-0 Acc. 1382	SP 53AB1-0 Acc. 1394	US 401 Acc. 1395	Monogerm SP 5515-01? Acc. 1396	Monogerm SP 5520-01? Acc. 1397	LSD Odds 19:1
		Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Gremel, H. Sebewaing, Mich.	Reeve Berrett	24.03	23.77	23.25	23.81	25.24	23.84	24.98	24.22	22.49	N.S.
Rader, E. Saginaw, Mich.1/	Reeve Berrett	17.48	15.99	15.30	14.74	16.82	15.21	17.63	15.77	15.44	1.68
Gordon, R. Croswell, Mich.	Reeve Berrett	18.30	17.03	16.72	16.38	16.51	16.44	17.06	18.38	16.50	N.S.
Detroit Stake Merrill, Mich.	Reeve Berrett	10.89	10.59	10.08	9.88	10.98	11.45	11.51	10.31	8.97	N.S.
Schultz, W. Bay City, Mich.	Reeve Nichol	20.49	20.84	20.87	20.07	21.25	20.86	21.07	19.66	18.90	N.S.
U.S.D.A. East Lansing, Mich.	Bockstahler Hogaboam	12.45	13.04	13.96	12.27	12.77	13.63	12.74	10.93	11.42	1.46
Risser, L. Pandora, Ohio	Bockstahler Hogaboam	31.59	30.89	32.64	32.12	33.90	31.95	31.53	31.92	32.43	3.45
Haas, G. Fremont, Ohio	Brewbaker Bush	14.62	14.82	13.24	13.34	14.97	14.41	14.48	13.60	14.58	1.19
Krause, E. & K. Findlay, Ohio	Brewbaker Bush	17.35	17.56	16.33	15.87	15.96	17.32	18.03	16.59	16.92	1.40
Paulson Farm Chilton, Wisc.	Reeve Minielly	12.02	12.09	10.75	11.14	11.47	11.64	11.19	11.58	11.05	N.S.
Ottinger, T. Chaska, Minn.	Bissonnette	15.63	14.47	12.94	12.99	15.55	12.94	15.19	14.21	12.87	2.10
C. & D. Sugar Co. Wallaceburg, Ont.	Broadwell	20.51	21.02	20.09	20.22	19.69	19.02	19.75	20.89	19.33	N.S.
Lovell, L. Kippen, Ont.	Broadwell	18.50	18.37	17.05	17.03	17.63	17.83	18.86	19.51	18.59	N.S.
Mean of 13 tests in humid region		17.99	17.73	17.17	16.91	17.90	17.43	18.00	17.51	16.88	
US 401 as 100%		99.9	98.5	95.4	93.9	99.4	96.8	100.0	97.3	93.8	

1/ Results of test at Saginaw are reported as 5-plot averages.

Summary Table 3.--Sucrose percentages in agronomic tests conducted in the Great Lakes area in 1957 to evaluate US 401 and related varieties of sugar beets developed for the humid region. Results are given as 6-plot averages except as noted.1/

Grower and Location	Reported by	SP 5510-0 Acc. 1378	SP 5511-0 SP 5611-0	SP 5512-0 Acc. 1379	SP 5460-0 Acc. 1380	SP 5481-0 Acc. 1382	SP 53AB1-0 Acc. 1394	US 401 Acc. 1395	Monogerm SP 5515-01? Acc. 1396	Monogerm SP 5520-01? Acc. 1397	LSD Odds 19:1
		%	%	%	%	%	%	%	%	%	%
Gremel, H. Sebewaing, Mich.	Reeve Berrett	16.97	17.23	17.18	17.09	17.11	17.25	16.39	16.85	17.17	0.47
Rader, B. Saginaw, Mich.1/	Reeve Berrett	17.65	17.60	17.73	17.92	17.34	17.67	16.76	17.86	18.60	0.76
Gordon, R. Croswell, Mich.	Reeve Berrett	18.37	18.38	18.25	18.17	18.43	18.12	18.20	18.42	18.08	N.S.
Detroit Stake Merrill, Mich.	Reeve Berrett	17.81	17.91	17.81	17.65	17.21	17.99	17.58	17.63	17.12	N.S.
Schultz, W. Bay City, Mich.	Reeve Nichol	14.27	15.19	14.71	15.07	14.69	14.98	13.89	15.16	15.61	0.73
U.S.D.A. East Lansing, Mich.	Bockstahler Hogaboam	15.53	16.05	16.41	16.33	16.65	16.48	15.82	16.27	16.60	N.S.
Risser, L. Pandora, Ohio	Bockstahler Hogaboam	13.60	13.72	13.49	13.88	13.64	13.47	12.94	12.93	14.08	0.81
Haas. G. Fremont, Ohio	Brewbaker Bush	14.58	14.85	15.20	15.35	15.02	14.88	14.67	14.97	15.48	0.61
Krause, E. & K. Findlay, Ohio	Brewbaker Bush	15.88	15.82	15.83	15.52	15.62	15.77	15.60	16.02	16.02	0.61
Paulson Farm Chilton, Wisc.	Reeve Minielly	20.82	20.47	20.88	20.50	20.71	21.27	20.75	21.04	20.88	N.S.
Ottinger, T. Chaska, Minn.	Bissonnette	14.35	14.01	13.24	14.46	13.94	15.26	14.69	14.10	14.53	N.S.
C. & D. Sugar Co. Wallaceburg, Ont.	Broadwell	16.18	16.73	16.99	16.75	17.02	16.25	16.45	16.65	16.85	N.S.
Lovell, L. Kippen, Ont.	Broadwell	15.65	16.07	15.48	15.61	15.74	16.03	15.70	15.34	16.12	N.S.
Mean of 13 tests in humid region US 401 as 100%		16.28 101.1	16.46 102.2	16.40 101.8	16.48 102.3	16.39 101.7	16.57 103.9	16.11 100.0	16.40 101.8	16.70 103.7	

1/ Results of test at Saginaw are reported as 5-plot averages.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve.

Location: Harold Gremel farm, Sebewaing, Michigan.

Cooperation: F. & M. Beet Sugar Association.

Date of Planting: April 17.

Date of Harvest: November 6.

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 8 rows x 25 feet, 28" rows.

Harvested Area per plot for Root Yield: 6 inner rows x 18 feet, hand topped.

Samples for Sucrose Determinations: One 10-beet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed.

Recent Field History: 1956-beans, 300# 5-20-20 and 8 tons manure/A, 1955- Hay and pasture, no fertilizer; 1954- oats, 350# 5-20-20.

Fertilization of Beet Crop: 700# 5-20-20 under seed, 150# 10-10-10 with seed.

Leaf Spot Exposure: Light.

Black Root Exposure: None.

Other Diseases and Pests: None.

Soil and Seasonal Conditions: Moist seedbed, seasonal moisture adequate.

Reliability of Test: Excellent.

Cooperator : F. & M. Beet Sugar Association. Year : 1957

Location : Harold Gremel farm, Sebewaing, Michigan. Expt. 9-3

(Results given as 6 plot averages)

Variety and Description			Acre-Yield: Gross Sugar	Acre-Yield: Roots	Sucrose	Beets per 100' of row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM PC Syn.	8153	24.03	16.97	81
	5611-0	LS-BR-MM PC Syn.	8196	23.77	17.23	98
Acc 1379	5512-0	LS-BR-MM PC Syn.	7994	23.25	17.18	87
Acc 1380	5460-0	LS-BR-MM PC Sib.	8143	23.81	17.09	87
Acc 1382	5481-0	LS-BR-MM PC	8632	25.24	17.11	91
Acc 1394	53AB1-0	LS-BR-MM PC Pool	8220	23.84	17.25	[illegible]
Acc 1395	US 401	LS-BR-MM PC Mass sel	7339	24.98	16.39	87
Acc 1396		LS-BR-mm hybrid	8159	24.22	16.85	99
Acc 1397		LS-BR-mm hybrid	7717	22.49	17.17	93
General Mean			8061	23.96	17.03	90
S. E. Variety Mean			386	.79	.16	3
" " " as % of Gen. Mean			4.79	3.30	0.94	3.33
Diff. req. for sig. (Odds 19:1)			N.S.	N.S.	0.47	[illegible]

Variance Table

Random Block analysis

Source of variation	D/F [a]	Mean Squares: Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	1,164,999	3.7493	.5196	266
Between varieties	[illegible]	779,475	4.1171	.4393	197
Remainder-Error	40	892,973	3.7533	.1617	53
Total	53				
Calculated F value [b]		NS	NS	2.72*	3.72**

[a] D/F for Gross Sugar and Roots should be 5, 8, 39, 52 resp. - 1 missing plot.

[b] *F value significant at 5 % level, ** significant at 1 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve.

Location: Reed Gordon farm, Croswell, Michigan.

Cooperation: F. & M. Beet Sugar Association.

Date of Planting: May 8.

Date of Harvest: October 29.

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: 6 inner rows x 18 feet, hand topped.

Samples for Sucrose Determinations: One 10-beet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed.

Recent Field History: 1956-alfalfa, 10 tons manure/A., 1955-alfalfa, 1954- wheat, fall 200# 3-12-12, spring 200 # 10-10-10.

Fertilization of Beet Crop: 600 # 5-20-10.

Leaf Spot Exposure: None.

Black Root Exposure: None.

Other Diseases and Pests:

Soil and Seasonal Conditions: Moist seedbed, seasonal moisture adequate.

Reliability of Test: Excellent.

Cooperator : F. & M. Beet Sugar Association. Year : 1957

Location: Reed Gordon farm, Croswell, Michigan. Expt. 9-4

(Results given as 6 plot averages)

Variety and Description			Acre-Yield Gross Sugar	Acre-Yield Roots	Sucrose	Beets per 100' of row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM PC Syn.	6723	18.30	18.37	107
	5611-0	LS-BR-MM PC Syn.	6259	17.03	18.38	112
Acc 1379	5512-0	LS-BR-MM PC Syn.	6104	16.72	18.25	107
Acc 1380	5460-0	LS-BR-MM PC Sib.	5947	16.38	18.17	110
Acc 1382	5481-0	LS-BR-MM PC	6076	16.51	18.43	113
Acc 1394	53ABI-0	LS-BR-MM PC Pool	5958	16.44	18.12	106
Acc 1395	US 401	LS-BR-MM PC Mass sel.	6207	17.06	18.20	110
Acc 1396		LS-BR-mm hybrid	6771	18.38	18.42	108
Acc 1397		LS-BR-mm hybrid	5957	16.50	18.08	109
General Mean			6222	17.03	18.27	109
S.E.Variety Mean			211	.56	.21	3
" " " as % of Gen. Mean			3.39	3.29	1.15	2.75
Diff. req. for sig.(Odds 19:1)			602	N.S.	N.S.	N.S.

Variance Table

Random Block analysis

Source of variation	D/F a/	Mean Squares Gross Sugar	Mean Squares Roots	Mean Squares Sucrose	Mean Squares Beets per 100' row
Between replications	5	426,209	3.7572	.1761	252
Between varieties	8	603,859	3.6446	.1089	35
Remainder-Error	40	266,313	1.8910	.2641	59
Total	53				
Calculated F value b/		2.27*	NS	NS	NS

a/ D/F for Gross Sugar and Roots should be 5,8,39,52 resp. - 1 missing plot.

b/ * F value significant at 5 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve.

Location: Detroit Stake Farm, Merrill, Michigan.

Cooperation: F. &. M. Beet Sugar Assoc. and Detroit Stake Farm.

Date of Planting: June 5,

Date of Harvest: November 5.

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: [illegible] rows x 18 feet, hand topped.

Samples for Sucrose Determinations: One 10-bbet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed.

Recent Field History: 1956-corn, 400# 5-20-10, 1955- alfalfa pasture, 1954- alfalfa hay.

Fertilization of Beet Crop: 500 # 6-24-12.

Leaf Spot Exposure: None.

Black Root Exposure: Light, in seedling stage.

Other Diseases and Pests:

Soil and Seasonal Conditions: Moist seed bed. Heavy rains in July.

Reliability of Test: Fair.

Cooperator : F.&.M. Beet Sugar Assoc., Detroit Stake Farm. Year 1957

Location : Detroit Stake Farm, Merrill, Michigan. Expt. 9-6

(Results given as 6 plot averages)

Variety and Description	Acre-Yields Gross Sugar	Roots	Sucrose	Beets per 100' of row
	Pounds	Tons	Percent	Number
Acc 1378 5510-0 LS-BR-MM PC Syn.	3880	10.89	17.81	66
5611-0 LS-BR-MM PC Syn.	3793	10.59	17.91	77
Acc 1379 5512-0 LS-BR-MM PC Syn.	3585	10.08	17.81	68
Acc 1380 5460-0 LS-BR-MM PC Sib	3482	9.88	17.65	64
Acc 1382 5481-0 LS-BR-MM PC	3765	10.93	17.21	70
Acc 1394 53AB1-0 LS-BR-MM PC Pool	4120	11.45	17.99	79
Acc 1395 US 401 LS-BR-MM PC Mass Sel	4051	11.51	17.58	64
Acc 1396 LS-BR-mm hybrid	3635	10.31	17.63	67
Acc 1397 LS-BR-mm hybrid	3053	8.97	17.12	66
General Mean	3707	10.52	17.63	69
S.E. Variety Mean	19	.57	.22	4
" " " as % of Gen. Mean	5.	5.42	1.25	5.80
Diff. req. for sig. (Odds 19:1)	561	N.S.	N.S.	N.S.

Variance Table

Random Block analysis

Source of variation	D/F a/	Mean Squares Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	1,013,370	8.7658	.7717	44
Between varieties	8	621,048	3.9223	.5375	185
Remainder-Error	40	230,849	1.9540	.2956	89
Total	53				
Calculated F value b/		2.69*	NS	NS	NS

b/ * F value significant at 5 % level.

a/ D/F for Gross Sugar and Roots should be 5,8,38,51 resp. - 2 missing plots.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve, Grant Nichol.

Location: Walter Schultz farm, Bay City, Michigan.

Cooperation: F. &. M. Beet Sugar Assoc, Monitor Sugar Div.

Date of Planting: April 17.

Date of Harvest: October 2.

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: 6 rows x 18 feet, hand topped.

Samples for Sucrose Determinations: One 10-beet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed.

Recent Field History: 1956-beans, 250# 4-16-16, 1955- Wheat,450# 4-16-16, 1954- beets, 400# 0-20-20 fall plow down, 600# 4-16-16, 75# N side dressed.

Fertilization of Beet Crop: 400# 0-25-25 fall plow down, 775# 3-11-11, 75 # N side dressed.

Leaf Spot Exposure: None.

Black Root Exposure: None.

Other Diseases and Pests:

Soil and Seasonal Conditions: Seed bed moist, Seasonal moisture adequate.

Reliability of Test: Excellent.

Cooperator : F. & M. Beet Sugar Assoc., Monitor Sugar Div. Year : 1957

Location : Walter Schultz farm, Bay City, Michigan. Expt. 9-5

(Results given as 6 plot averages)

Variety and Description			Acre-Yields: Gross Sugar	Acre-Yields: Roots	Sucrose	Beets per 100' of row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM PC Syn.	5837	20.49	14.27	96
	5611-0	LS-BR-MM PC Syn.	6333	20.84	15.19	114
Acc 1379	5512-0	LS-BR-MM PC Syn.	6139	20.87	14.71	97
Acc 1380	5460-0	LS-BR-MM PC Sib.	6058	20.07	15.07	103
Acc 1382	5481-0	LS-BR-MM PC	6249	21.25	14.69	105
Acc 1394	53AB1-0	LS-BR-MM PC Pool	6265	20.86	14.98	115
Acc 1395	US 401	LS-BR-MM PC Mass Sel.	5855	21.07	13.89	101
Acc 1396		LS-BR-mm hybrid	5940	19.66	15.16	104
Acc 1397		LS-BR-mm hybrid	5904	18.90	15.61	115
General Mean			6064	20.45	14.84	105
S.E.Variety Mean			2	.63	.26	4
" " " as % of Gen. Mean			3.48	3.08	1.75	3.81
Diff. req. for sig. (Odds 19:1)			N.S.	N.S.	0.73	12

Variance Table

Random Block analysis

Source of variation	D/F a/	Mean Squares: Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	1,611,983	15.4690	.1994	2/32
Between varieties	8	216,789	3.5252	1.6160	339
Remainder-Error	40	266,245	2.3566	.3946	100
Total	53				
Calculated F value b/		NS	NS	4.10**	3.39**

a/ D/F for Gross Sugar and Roots should be 5, 8, 39, 52 resp.- 1 missing value.

b/ ** F value significant at 1 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: H. W. Bockstahler, G. J. Hogaboam.

Location: M.S.U. Farm Crops Dept. farm, East Lansing, Michigan.

Cooperation : Michigan Agr. Expt. Station.

Date of Planting : May 31.

Date of Harvest: October 14.

Experimental Design : 3 x 3 Triple Lattice, 9 replications.

Size of Plots : 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield : 6 rows x 18 feet, hand topped.

Samples for Sucrose Determinations : Two samples, one from each of two rows. Number of beets in samples varied according to numbers of beets remaining in the rows.

Stand and Bolter Counts : Stand counted after thinning. Harvested beets counted when weighed. Bolters negligible.

Recent Field History: Planted in black root nursery area. Several years continuous beets after beets.

Fertilization of Beet Crop : 1000 # 5-20-20 broadcast in early May and plowed down. 150 # 5-20-10 in the row.

Leaf Spot Exposure : None.

Black Root Exposure : Severe .

Other Diseases and Pests :

Soil and Seasonal Conditions : Minimum seed bed preparation- one or two times over with spike-tooth harrow after plowing. Seed bed moist. Moisture adequate remainder of season, irrigated when necessary.

Reliability of Test : Good.

Cooperator : Mich. Agr. Expt. Station-Farm Crops Dept. Year: 1957

Location : East Lansing, Michigan Expt. 9-8

(Results given as 6 plot averages)

Variety and Description	Acre-Yields: Gross Sugar	Acre-Yields: Roots	Sucrose	Beets per 100' of row
	Pounds	Tons	Percent	Number
Acc 1378 5510-0 LS-BR-MM-PC Syn.	3888	12.45	15.53	74
5611-0 LS-BR-MM PC Syn.	4204	13.04	16.05	99
Acc 1379 5512-0 LS-BR-MM PC Syn.	4585	13.96	16.41	92
Acc 1380 5460-0 LS-BR-MM PC Sib	4008	12.27	16.33	100
Acc 1382 5481 LS-BR-MM PC	4268	12.77	16.65	100
Acc 1394 53AB1-0 LS-BR-MM PC Pool	4490	13.63	16.48	97
Acc 1395 US 401 LS-BR-MM Pc Mass Sel	4053	12.74	15.82	93
Acc 1396 LS-BR-mm hybrid	3571	10.93	16.27	95
Acc 1397 LS-BR-mm hybrid	3817	11.42	16.60	97
General Mean	4098	12.58	16.24	94
S.E. Variety Mean	208	.51	.26	3
" " " % of Gen. Mean	5.08	4.05	1.60	3.19
Diff. req. for sig. (Odds 19:1)	595	1.46	N.S.	[illegible]

Variance Table

Random Block analysis

Source of variation	D/F	Mean Squares: Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	2,120,078	12.0932	3.2646	907
Between varieties	8	631,748	5.5707	.8278	383
Remainder-Error	40	260,074	1.5670	.4210	61
Total	53				
Calculated F value a/		2.43*	3.56**	NS	6.28**

a/ * F value significant at 5 % level, ** significant at 1 % level.

AGRONOMIC EVALUATION TEST

Conducted by: H. E. Brewbaker and H. L. Bush

Location: Glen Haas Farm, Fremont, Ohio

Cooperation: Northern Ohio Sugar Company

Date of Planting: May 2, 1957

Date of Harvest: September 17, 18, 1957

Experimental Design: Randomized Complete Block

Size of Plots: 6 rows x 22 feet planted (32 inch rows)

Harvested Area per Plot for Root Yield: 6 rows x 18 feet

Samples for Sucrose Determinations: 2 samples per plot, each 1 row x 18 feet

Stand and Bolter Counts: Beets counted in laboratory for stand. No bolters developed in this test.

Recent Field History: 1956 tomatoes, spring plowed 1957

Fertilization of Beet Crop: 500 pounds per A. 12-12-12 plowed under, 250 pounds per A. 3-18-9 drilled with seed.

Leaf Spot Exposure: Probably moderate, with fairly complete recovery by harvest time. No readings made since field was not visited by member of Exp. Station staff at the proper time.

Black Root Exposure: No seedling disease and very little mature rot.

Curly Top Exposure: None noted

Other Diseases: None noted

Soil and Seasonal Conditions: Period of dry conditions during August but otherwise the season was fairly normal. Rains in early September induced rapid growth. Tops dark green when harvested.

Cooperator: Northern Ohio Sugar Company by H. E. Brewbaker and H. L. Bush   Year: 1957

Location: Glen Haas Farm, Fremont, Ohio

(Results given as 6 plot averages)

Variety	Acre Yield: Sugar: Recoverable[a] (lbs.)	Acre Yield: Sugar: Gross (lbs.)	Acre Yield: Roots (tons)	Sucrose (%)	Thin Juice App. Purity (%)	Beets per 100 Ft. (No.)
Acc. 1397	3738	4514	14.58	15.48	91.52	140
Acc. 1382	3672	4497	14.97	15.02	90.96	140
SP5611-0	3667	4402	14.82	14.85	91.80	134
Acc. 1394	3485	4288	14.41	14.88	90.77	146
US401	3443	4248	14.48	14.67	90.68	135
Acc. 1378	3439	4263	14.62	14.58	90.48	135
Acc. 1379	3349	4025	13.24	15.20	91.75	129
Acc. 1380	3303	4095	13.34	15.35	90.43	131
Acc. 1396	3266	4072	13.60	14.97	90.23	139
General Mean	3485	4267	14.23	15.00	90.96	137
S.E. Variety Mean	-	138.93	.4176	.2129	.4085	-
S.E. Variety Mean as % of Gen. Mean	-	3.26	2.94	1.42	0.45	-
Diff. req. for Sig. (Odds 19:1)	324[b]	397	1.19	0.61	1.17	-

Variance Table

Source of Variation	DF	Mean Squares: Gross Sugar[c] (lbs.)	Mean Squares: Roots (tons)	Mean Squares: Sucrose (%)	Mean Squares: Purity (%)
Replicates	5	-	2.0123	.4040	.9880
Varieties	8	-	2.5756	.5388	2.0900
Error	40	-	1.0456	.2718	1.0008
Total	53	-	1.3677	.3245	1.1640
Calculated F value	-	-	2.46*	NS	NS

(a, (b, (c See attached sheet for footnotes, on page 176

AGRONOMIC EVALUATION TEST

Conducted by: H. E. Brewbaker and H. L. Bush

Location: Ernest and Kenneth Krause Farm, Findlay, Ohio

Cooperation: Northern Ohio Sugar Company

Date Of Planting: May 1, 1957

Date Of Harvest: September 19, 20, 1957

Experimental Design: Randomized Complete Block

Size of Plots: 6 rows x 22 feet planted (30 inch rows)

Harvested Area for Root Yield: 6 rows x 18 feet

Samples for Sucrose Determinations: 2 samples per plot, each 1 row x 18 feet.

Stand and Bolter Counts: No bolters developed in this test.
Beets counted in laboratory for stand.

Recent Field History: 1954, 1955, 1956 alfalfa, spring plowed 1957.

Fertilization of Beet Crop: 450 pounds per A. 10-10-10, plowed under,
250 pounds per A. 6-24-12 drilled with seed.

Leaf Spot Exposure: Very little evidence of disease.

Black Root Exposure: Practically no root rot evident throughout the season in this field except in Replicate 1 where there was a slight loss in seedling stand before thinning.

Curly Top Exposure: None noted

Other Diseases: None noted

Soil and Seasonal Conditions: Drought not so severe as at Fremont but some yellowing occurred as a result of dry conditions. Tops dark green at harvest time.

Cooperator: Northern Ohio Sugar Company by H. E. Brewbaker and H. L. Bush Year: 1957

Location: Ernest and Kenneth Krauss Farm, Findlay, Ohio

(Results given as 6 plot averages)

Variety	Acre Yield: Sugar Recoverable[a] (lbs.)	Acre Yield: Sugar Gross (lbs.)	Acre Yield: Roots (tons)	Sucrose (%)	Thin Juice App. Purity (%)	Beets per 100 Ft. (No.)
US401	4580	5625	18.03	15.60	90.82	104
SP5611-0	4512	5556	17.56	15.82	90.68	111
Acc. 1397	4381	5421	16.92	16.02	90.48	105
Acc. 1378	4379	5510	17.35	15.88	89.82	110
Acc. 1394	4371	5463	17.32	15.77	90.08	108
Acc. 1396	4340	5315	16.59	16.02	90.90	105
Acc. 1379	4239	5170	16.33	15.83	91.07	96
Acc. 1382	4068	4986	15.96	15.62	90.50	105
Acc. 1380	3837	4926	15.87	15.52	89.07	101
General Mean	4301	5330	16.88	15.79	90.38	105
S.E.Variety Mean	-	171.20	.4916	.2143	.3757	-
S.E. Variety Mean as % of Gen. Mean	-	3.21	2.91	1.36	0.42	-
Diff. req. for Sig. (Odds 19:1)	395	489	1.40	0.61	1.07	-

Variance Table

Source of Variation	DF	Mean Squares: Gross Sugar[c] (lbs.)	Roots (tons)	Sucrose (%)	Purity (%)
Replicates	5	-	5.1209	.6140	1.9500
Varieties	8	-	3.3470	.1913	2.3850
Error	40	-	1.4495	.2753	.8465
Total	53	-	2.0823	.2945	1.1828
Calculated F Value	-	-	2.31*	NS	2.82*

(a, (b, (c See attached sheet for footnotes, or page 176

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve, E. G. Minielly

Location: Poulson farm, Chilton, Wisconsin.

Cooperation: F. & M. Beet Sugar Assoc. and Menominee Sugar Co.

Date of Planting: May 3.

Date of Harvest: October 15.

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 8 rows x 20 feet, 24" rows.

Harvested Area per Plot for Root Yields: 6 rows x 18 feet, hand topped.

Samples for Sucrose Determinations: One 10-beet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed.

Recent Field History: 1956- oats, no fertilizer.

Fertilization of Beet Crop: 200 # 0-0-60 broadcast, 165# 4-16-16.

Leaf Spot Exposure: None.

Black Root Exposure: None.

Other Diseases and Pests:

Soil and Seasonal Conditions: Seed bed dry. Late summer moisture was inadequate.

Reliability of Test: Good.

Cooperator: F. & M. Beet Sugar Association, Menominee Sugar Co. Year: 1957

Location : Paulson Farm, Chilton, Wisconsin. Expt. 9-1

(Results given as 6 plot averages)

Variety and Description			Acre-Yield Gross Sugar	Acre-Yield Roots	Sucrose	Beets per 100' of Row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM PC Syn.	4997	12.02	20.82	86
	5611-0	LS-BR-MM PC Syn.	4936	12.09	20.47	91
Acc 1379	5512-0	LS-BR-MM PC Syn.	4485	10.75	20.88	81
Acc 1380	5460-0	LS-BR-MM PC Sib.	4568	11.14	20.50	88
Acc 1382	5481-0	LS-BR-MM PC	4748	11.47	20.71	91
Acc 1394	53AB1-0	LS-BR-MM PC Pool	4944	11.64	21.27	91
Acc 1395	US 401	LS-BR-MM PC Mass sel.	4640	11.19	20.75	86
Acc 1396		LS-BR-mm hybrid	4877	11.58	21.04	91
Acc 1397		LS-BR-mm hybrid	4615	11.05	20.88	86
General Mean			4757	11.44	20.81	88
S.E. Variety Mean			157.3	.38	.21	3.25
" " " as % of Gen. Mean			3.31	3.32	1.	3.70
Diff. req. for sig. (Odds 19:1)			N.S.	N.S.	N.S.	N.S.

Variance Table

Random Block analysis

Source of variation	D/F	Mean Squares Gross Sugar	Mean Squares Roots	Mean Squares Sucrose	Mean Squares Beets per 100' row
Between replications	5	672,710	4.8763	.6794	36.20
Between varieties	8	211,967	1.1957	.3757	69.88
Remainder-Error	40	148,585	.8544	.2628	63.43
Total	53				
Calculated F value		NS	NS	NS	NS

AGRONOMIC EVALUATION TEST- 1957

Conducted by: H. L. Bissonnette

Location: Ted Ottinger farm, Chaska, Minnesota

Cooperation: American Crystal Sugar Co. & U. of Minnesota.

Date of Planting: May 2

Date of Harvest: September 27

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 6 rows x 30 feet; 22" rows.

Harvested area per plot for Root Yield: 4 inner rows x 30 feet. All beets topped by hand and weighed.

Samples for Sucrose Determinations: Two 10-beet samples randomly selected from each plot.

Stand and Bolter Counts: Stands counted after thinning and at harvest.

Recent Field History: 1956 oats & alfalfa; 1955 corn.

Fertilization of Beet Crop: Winter 1956-57 8-10 Tons manure/A.
Spring 1957 300# 16-32-8 /A.

Leaf Spot Exposure: Disease incidence was not great enough for reliable readings.

Black Root Exposure: none observed.

Other Diseases and Pests: Rhizoctonia crown rot appeared throughout the plot but did not appear serious.

Soil and Seasonal Conditions: Dry spring, sufficient to excessive moisture July through September. The thinning operation, mechanical, caused a loss of stand in several plots because the blades were dragging in the soil as a result of the rough seed-bed. Therefore the rows were harvested to equal out the plots. The remaining portion of the field outside of the test area had a tonnage that was below the average for the district which could have been due to the thinning operation and/or excess moisture.

Reliability of Test: Fair.

Cooperator : Amer. Crystal Sugar Co., & Minn. Agr. Expt. Sta. Year: 1957

Location: Ted Ottinger farm, Chaska, Minnesota. Expt. 9-9

(Results given as 6 plot averages)

Variety and Description	Acre-Yields: Gross Sugar	Acre-Yields: Roots	Sucrose	Beets per 100' of row
	Pounds	Tons	Percent	Number
Acc 1378 5510-0 LS-BR-MM PC Syn.	4504	15.63	14.35	83
5611-0 LS-BR-MM PC Syn.	4034	14.47	14.01	87
Acc 1379 5512-0 LS-BR-MM PC Syn.	3432	12.94	13.24	81
Acc 1380 5460-0 LS-BR-MM PC Sib	3752	12.99	14.46	87
Acc 1382 5481-0 LS-BR-MM PC	4342	15.55	13.94	90
Acc 1394 53AB1-0 LS-BR-MM PC Pool	3944	12.94	15.26	84
Acc 1395 US 401 LS-BR-MM PC Mass Sel	4459	15.19	14.69	91
Acc 1396 LS-BR-mm hybrid	3977	14.21	14.10	85
Acc 1397 LS-BR-mm hybrid	3704	12.87	14.53	81
General Mean	4016	14.09	14.29	85
S. E. Variety Mean	231	.74	.46	5
" " " as % of Gen. Mean	5.75	5.25	3.22	5.88
Diff. req.for sig. (Odds 19:1)	659	2.10	N.S.	N.S.

Variance Table

Random Block analysis

Source of Variation	D/F	Mean Squares: Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	996,240	13.2417	1.7469	178
Between varieties	8	791,501	8.4051	1.8914	81
Remainder-Error	40	319,442	3.2528	1.2586	138
Total	53				
Calculated F value a/		2.48*	2.58*	NS	NS

a/ *F value significant at 5 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: C. E. Broadwell.

Location: C. & D. Sugar Co.,Ltd. experimental farm, Wallaceburg,Ontario.

Cooperation: C. & D. Sugar Co.,Ltd. and F. & M. Beet Sugar Assoc.

Date of Planting: April 24.

Date of Harvest: October 21.

Experimental Design: 3 x 3 Triple Lattice.

Size of Plots: 8 rows x 25 feet, 24" rows.

Harvested area per Plot for Root Yield: 4 center rows x 25 feet.

Samples for Sucrose Determinations: Two 8-beet samples taken at random.

Stand and Bolter Counts: Stand based on beet containing inches in 100". Beets counted at harvest.

Recent Field History: 1956-soy beans, 1955-clover, 1954-oats, 1953-beets.

Fertilization of Beet Crop: 500 # 2-12-20.

Leaf Spot Exposure: None

Black Root Exposure: Some blackroot.

Other Diseases and Pests:

Soil and Seasonal Conditions: Seeded heavily, emergence light, several rains after planting so drought not a factor.

Reliability of Test: Fairly good.

Cooperator : F. & M. Beet Sugar Assoc., C. & D. Sugar Co., LTD. Year: 1957

Location : C. & D. Experimental Farm, Wallaceburg, Ontario, Canada. Expt. 9-2

(Results given as 6 plot averages)

Variety and Description			Acre-Yield Gross Sugar	Acre-Yield Roots	Sucrose	Beets per 100' of row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM-PC Syn.	6643	20.51	16.18	69
	5611-0	LS-BR-MM PC Syn.	7020	21.02	16.73	78
Acc 1379	5512-0	LS-BR-MM PC Syn.	6826	20.09	16.99	80
Acc 1380	5460-0	LS-BR-MM-PC Sib.	6785	20.22	16.75	80
Acc 1382	5481-0	LS-BR-MM PC	6692	19.69	17.02	79
Acc 1394	53AB1-0	LS-BR-MM PC Pool	6176	19.02	16.25	73
Acc 1395	US 401	LS-BR-MM PC Mass sel.	6511	19.75	16.45	76
Acc 1396		LS-BR-mm hybrid:	6969	20.89	16.65	73
Acc 1397		LS-BR-mm hybrid:	6503	19.33	16.85	83
General Mean			6680	20.06	16.65	77
S. E. Variety Mean			301.	.86	.26	4
" " " as percent of Gen.Mean			4.51	4.29	1.56	5.19
Diff. req. for sig. (Odds 19:1)			N.S.	N.S.	N.S.	N.S.

Variance Table

Randon Block analysis

Sourbe of Variation	D/F	Mean Squares Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	715,912	4.0472	.5947	22
Between varieties	8	410,483	2.7637	.5434	117
Remainder-Error	40	545,108	4.4787	.4162	82
Total	53				
Calculated F value		NS	NS	NS	NS

AGRONOMIC EVALUATION TEST* 1957

Conducted by: C. E. Broadwell.

Location: Lloyd Lovell farm, Kippen, Ontario, Canada.

Cooperation: C. & D. Sugar Co., Ltd., & F. & M. Beet Sugar Assoc.

Date of Planting: May 1.

Date of Harvest: October 21.

Experimental Design: 5 x 5 Triple Lattice.

Size of Plots: 8 rows x 25 feet; 24" rows.

Harvested area per Plot for Root Yields: 4 center rows x 25 feet.

Samples for Sucrose Determination: Two 8-beet samples taken at random.

Stand and Bolter Counts: Stand based on beet containing inches in 100 inches. Beets counted at harvest.

Recent Field History: 1956 beans, 1955 corn, 1954 soy beans.

Fertilization of Beet Crop: 125# cyanamid plowed down, 350# 4-24-12

Leaf Spot Exposure: Some leaf spot.

Black Root Exposure: None

Other Diseases and Pests: Some crown rot.

Soil and Seasonal Conditions: Seedlings emerged very thickly and assured a good post thinning stand.

Reliability of Test: . Fairly good.

Cooperator: F.& M. Beet Sugar Assoc., C. &. D. Sugar Co., LTD. Year: 1957

Location: Lloyd Lovell farm, Kippen, Ontario, Canada. Expt: 9-7

(Results given as 6 plot averages)

Variety and Description	Acre- Yields: Gross Sugar	Acre- Yields: Roots	Sucrose	Beets per 100' of row
	Pounds	Tons	Percent	Number
Acc 1378 5510-0 LS-BR-MM PC Syn.	5790	18.50	15.65	65
5611-0 LS-BR-MM-PC Syn.	5903	18.37	16.07	69
Acc 1379 5512-0 LS-BR-MM PC Syn.	5268	17.05	15.48	62
Acc 1380 5460-0 LS-BR-MM PC Sib	5311	17.03	15.61	65
Acc 1382 5481-0 LS-BR-MM PC	5537	17.63	15.74	65
Acc 1394 53AB1-0 LS-BR-MM PC Pool	5732	17.83	16.03	66
Acc 1395 US 401 LS-BR-MM-PC Mass Sel	5922	18.86	15.70	69
Acc 1396 LS-BR-mm hybrid	5992	19.51	15.34	72
Acc 1397 LS-BR-mm hybrid	5982	18.59	16.12	73
General Mean	5715	18.15	15.75	67
S.E. Variety Mean	213	.68	.28	2
" " " as % of Gen. Mean	3.73	3.75	1.78	2.99
Diff. req. for sig. (Odds 19:1)	N.S.	N.S.	N.S.	6

Variance Table

Random block analysis

Source of Variation	D/F	Mean Squares: Gross Sugar	Roots	Sucrose	Beets per 100' row
Between blocks(replications)	5	872,758	4.7573	.6393	216
Between varieties	8	470,620	4.1859	.4356	80
Remainder-Error	40	273,473	2.7601	.4551	28
Total	53				
Calculated F value a/		NS	NS	NS	2.86*

a/ * F value significant at 5 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve.

Location: Elmer Rader farm, Saginaw, Michigan.

Cooperation: F. & M. Beet Sugar Assoc.

Date of Planting: May 4.

Date of Harvest: October 11.

Experimental Design: 6 x 6 Triple Lattice, 4 x 5 Rectangular Lattice, 6 reps. each

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: 6 rows x 18 feet, hand topped.

Samples for Sucrose Determinations: one 10-beet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed. In the 6 x 6 set of varieties, Entry # 27, 5633-01, almost one third of the plants of this variety bolted. Afew other varieties showed an occasional bolter.

Recent Field History: 1956- alfalfa plowed down in June, 1955- oats seeded to alfalfa, 300# 5-20-20, 1954- beets- 500 # 5-20-20.

Fertilization of Beet Crop: 400 # 6-24-12.

Leaf Spot Exposure: Moderate.

Black Root Exposure: Light, in seedling stage.

Other Diseases and Pests:

Soil and Seasonal Conditions: Dry seed bed. Heavy rains in July. Moisture adequate balance of season. Flood waters from the river drowned out several plots in the sixth replication of the 6 x 6 . Records from the remaining plots of this replication were omitted from the summary.

Reliability of Test: Excellent.

Cooperator: F. & M. Beet Sugar Association. Year: 1957

Location : Elmer Rader farm, Saginaw, Michigan. Expt. 36-1

(Results given as 5 plot averages)

Variety and Description			Acre-Yields Gross Sugar	Roots	Sucrose	Beets per 100' of row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM PC Syn.	6165	17.48	17.65	96
	5611-0	LS-BR-MM PC Syn.	5613	15.99	17.60	94
Acc 1379	5512-0	LS-BR-MM PC Syn.	5423	15.30	17.73	84
Acc 1380	5460-0	LS-BR-MM PC Sib	5288	14.74	17.92	96
Acc 1382	5481-0	LS-BR-MM PC	5823	16.82	17.34	99
Acc 1394	53AB1-0	LS-BR-MM PC Pool	5367	15.21	17.67	85
Acc 1395	US 401	LS-BR-MM PC Mass sel	5897	17.63	16.76	87
Acc 1396		LS-BR-mm hybrid	5642	15.77	17.86	89
	5515-01 MSmm X (5460-0)&(US 401)					
Acc 1397		LS-BR-mm hybrid	5742	15.44	18.60	97
	5520-01 MSmm X (5460-0)&(US 401)					
Acc 1381	5480-0	LS-BR-MM PC	5604	16.23	17.26	97
Acc 1391	US 400	LS-BR-MM PC mass sel	5032	14.64	17.19	92
Acc 1368		LS-BR-mm hybrid	5169	14.52	17.82	88
	(SLC 610x91MS) X US 400					
Acc 2058	US 225MS x US 401	LSBRMM hybrid	5847	16.63	17.61	97
56400-01	Self-steriles	LS-BR-MM PC	6164	17.61	17.49	97
56454-01	Self-steriles	LS-BR-MM PC	6235	18.08	17.25	95
Kohls	345s55M-2	LS-BR-MM	5555	16.61	16.74	87
5621-01		LS-BR-mm hybrid	5924	16.11	18.39	93
5622-00		LS-BR-mm hybrid	6102	17.18	17.77	93
5624-01		LS-BR-mm hybrid	5845	16.15	18.10	88
5625-01		LS-BR-mm hybrid	6344	17.60	18.03	92
5626-01		LS-BR-mm hybrid	5876	16.28	18.03	88
5627-00		LS-BR-mm hybrid	5767	16.08	17.95	94
5628-01		LS-BR-mm hybrid	5962	16.65	17.92	89
5629-00		LS-BR-mm hybrid	6331	17.25	18.36	95
5630-01		LS-BR-mm hybrid	6104	17.24	17.72	93
5632-01		LS-BR-mm hybrid	5865	16.51	17.78	94
5633-01		LS-BR-mm hybrid	4655	13.50	17.23	88
Acc 1384		LS-BR-mm hybrid	6191	16.70	18.59	93
	5520-01MSmm X 5460-0					
Acc 1385		LS-BR-mm hybrid	5526	15.82	17.46	86
	5515-01MSmm X US 401					
U-I	(610x91x108)MS x 5460-0	LSBRmm hyb	5728	15.95	17.92	90
U-I	(610x91x108)MS x US 401	LS-BR-mm hyb	5803	16.51	17.57	90
U-I	(610x91x110)MS x 5460-0	LS-BR-mm hyb	5644	15.66	18.04	84
Acc 1392	US 401	LS-BR-MM PC mass sel	5695	16.96	16.79	96
Acc 1393	US 401 Stock	LS-BR-MM PC mass sel	5939	18.22	16.35	94
561812-00	US 400 sel.	LS-BR-MM PC mass sel	6271	17.70	17.71	98
561813-00	US 400 sel.	LS-BR-MM PC mass sel	5718	16.41	17.47	84
General Mean			5774	16.37	17.66	92
S.E. Variety Mean			213	.60	.27	4
" " " as % of Gen. Mean			3.69	3.67	1.53	4.35
Diff. req. for sig. (Odds 19:1)			596	1.68	.76	N.S.

Variance Table

Random Block analysis

Source of Variation	D/F	Mean Squares Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	4	687,331	8.0871	2.1885	348
Between varieties	35	689,795	5.6311	1.2654	97
Remainder-Error	140	227,519	1.8140	.3705	89
Total	179				
Calculated F value [a]		3.03**	3.10**	3.42**	NS

[a] ** F value significant at 1 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: H. W. Bockstahler, G. J. Hogaboam.

Location: Louis Risser, Jr. farm, Pandora, Ohio .

Cooperation: F. & M. Beet Sugar Assoc. and Buckeye Sugars, Inc.

Date of Planting: May 1 & 2.

Date of Harvest: November 6-13.

Experimental Design: 6 x 6 Triple Lattice, 4 x 5 Rectangular Lattice, 6 replications each.

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: 6 rows x 17 feet, machine harvested- Marbeet Jr. harvester. All plot numbers ending in 3 and 4 - four rows x 17 feet. For analysis, yields were converted to six row basis. Rains during harvest period prevented completion of yield records. Acre yields for these two experiments were exceptionally high due to mud clinging to the beets and in the weighing tubs, however, the relative ranking of the varieties should be acceptible. US 401, surrounding test plots, harvested earlier yielded 23 tons per acre.

Samples for Sugar Determinations: One 10-beet sample from each of two rows from each plot. Picked from tub after weighing. Excess beets over ten discarded. All plots ending in 3 - one sample per plot.

Stand and Bolter Counts: Beets counted from tubs after weighing. Beets missed by harvester gleaned immediately behind machine. In the 6 x 6 set of varieties, Entry # 27, 5633-01, showed almost one third of the plants bolted. A few other varieties showed an occasional bolter.

Recent Field History: 1946-56 pasture. 1953-56 50# N /A. each year. 1952- 1000# rock phosphate/A. 1945- Wheat. 1900 ?-45 pasture.

Fertilization of Beet Crop: 222 # 11-48-0 with .75 % Thiram

Leaf Spot Exposure: Severe in 4 x 5 , Moderate in 6 x 6. Field had never grown beets previously.

Black Root Exposure: None.

Other Diseases and Pests: None.

Soil and Seasonal Conditions: Seed bed moist. Moisture adequate entire season.

Reliability of Test: Good.

Cooperator: F. & M. Beet Sugar Assoc., & Buckeye Sugars, Inc. Year: 1957

Location: Louis Risser, Jr. farm, Pandora, Ohio. Expt. 36-2

Variety and Description			Acre- Yields Gross Sugar	Roots	Sucrose	Beets per 100' of row
			Pounds	Tons	Percent	Number
Acc 1378	5510-0	LS-BR-MM PC Syn	8570	31.59	13.60	74
	5611-0	LS-BR-MM PC Syn	8443	30.89	13.72	93
Acc 1379	5512-0	LS-BR-MM PC Syn	8788	32.64	13.49	85
Acc 1380	5460-0	LS-BR-MM PC Sib	8899	32.12	13.88	85
Acc 1382	5481-0	LS-BR-MM PC	9251	33.90	13.64	91
Acc 1394	53AB1-0	LS-BR-MM PC Pool	8573	31.95	13.47	84
Acc 1395	US 401	LS-BR-MM PC Mass sel	8156	31.53	12.94	90
Acc 1396		LS-BR-mm hybrid	8255	31.92	12.93	99
	5515-01 MSmm X (5460-0)&(US 401)					
Acc 1397		LS-BR-mm hybrid	9126	32.43	14.08	98
	5520-01 MSmm X (5460-0) & (US 401)					
Acc 1381	5480-0	LS-BR-MM PC	8679	33.78	12.80	89
Acc 1391	US 400	LS-BR-MM PC mass sel	8864	33.30	13.32	92
Acc 1368		LS-BR-mm hybrid	7553	29.15	13.09	94
	(SLC 610x91MS) X US 400					
Acc 2058	US 225MSxUS401	LS-BR-MM hybrid	9554	35.99	13.28	97
56400-01	Self-steriles	LS-BR-MM PC	8962	34.90	12.86	85
56454-01	Self-steriles	LS-BR-MM PC	8581	32.99	13.04	86
Kohls	345s55M-2	LS-BR-MM	7560	30.89	12.25	82
5621-01		LS-BR-mm hybrid	9460	33.69	14.06	97
5622-00		LS-BR-mm hybrid	9631	34.64	13.93	95
5624-01		LS-BR-mm hybrid	9054	31.18	14.50	93
5625-01		LS-BR-mm hybrid	10053	35.32	14.25	101
5626-01		LS-BR-mm hybrid	9244	33.55	13.75	96
5627-00		LS-BR-mm hybrid	9263	33.66	13.77	99
5628-01		LS-BR-mm hybrid	9512	35.75	13.38	96
5629-00		LS-BR-mm hybrid	9585	34.09	14.11	99
5630-01		LS-BR-mm hybrid	9623	35.99	13.39	105
5632-01		LS-BR-mm hybrid	9022	33.23	13.63	98
5633-01		LS-BR-mm hybrid	7085	26.55	13.33	93
Acc 1384		LS-BR-mm hybrid	9533	34.38	13.94	97
	5520-01MSmm X 5460-0					
Acc 1385		LS-BR-mm hybrid	8340	31.71	13.14	84
	5515-01MSmm X US 401					
U-I (610x91x108)MS x 5460-0 LSBRmm hyb.			8511	32.46	13.17	88
U-I (610x91x108)MS x US 401 LSBRmm hyb.			7600	28.99	13.18	87
U-I (610x91x110)MS x 5460-0 LS-BRmm hyb.			8084	29.73	13.68	89
Acc 1392	US 401	LS-BR-MM PC mass sel	8153	31.33	13.03	90
Acc 1393	US 401 Stock	LS-BR-MM PC mass sel	8171	31.43	13.05	85
Acc 1387 SL 91MSmm x 5460-0 LSBRmm hybrid			8537	32.20	13.33	90
Acc 1388 SL 91MSmm x US 401 LSBRmm hybrid			8959	34.35	13.03	98
General Mean			8756	32.62	13.44	92
S.E. Variety Mean			348	1.23	.29	3
" " " as % of Gen. Mean			3.97	3.77	2.16	3.26
Diff. req. for sig. (Odds 19:1)			972	3.45	.81	9

Variance Table

Random Block analysis

Source of variation	D/F	Mean Squares Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	10,278,367	175.2203	10.5498	65
Between varieties	35	2,847,322	25.7986	1.3475	259
Remainder-Error	175	728,227	9.1425	.5010	56
Total	215				
Calculated F value a/		3.91**	2.82**	2.69**	4.63**

a/ ** F value significant at 1 % level.

Comments Concerning Screening Tests

Conducted at Saginaw, Michigan,

and Pandora, Ohio

The description of the 36 varieties and hybrids included in the screening tests conducted at Saginaw, Michigan, by P. A. Reeve and M. R. Berrett is given on Page 154. The test conducted at Pandora, Ohio, by H. W. Bockstahler and G. J. Hogaboam is given on Page 156. The results of the two tests have been given in Summary Table 4 on Page 159. The nine varieties described on Page 127 and included in each of these tests have been included in the Summary Tables 1, 2, and 3 given on Page 128, 129, and 130, respectively.

In the evaluation of entries in these two tests U.S. 401, used as Acc. 1395, should be considered a standard for comparison. These tests afford the only opportunity in this report to compare the performances of U.S. 401 and U.S. 400, which is included as Acc. 1391. It can be noted that in the test at Saginaw, Michigan, where there was black root and moderate leaf spot, U.S. 400 and U.S. 401 do not differ significantly in sucrose percentage; but U.S. 401 is statistically superior to U.S. 400 in acre yield of roots. This superior performance in root yield is reflected in a significantly higher yield of gross sugar for U.S. 401 over U.S. 400. In the test at Pandora, Ohio, where black root was absent, U.S. 400 and U.S. 401 did not differ significantly in any of the categories of comparison.

Attention is directed to the performances of Entries 17 through 27, which are monogerm hybrids. It is evident that the sister sublines pooled to give SP 5515-01 and SP 5520-01 as increased by the West Coast Beet Seed Company do not have equal combining ability. Attempts are being made to recover the superior "O" types of the male-sterile equivalents used to give the outstanding hybrids such as SP 5625-01.

Description of New Breeder Seed and Monogerm Hybrids in Agronomic Tests Conducted at Saginaw, Michigan, and Pandora, Ohio

All of the entries in these tests have a history of breeding for resistance to leaf spot and black root as varieties or as parental material in the hybrids. The breeding history is given below with the following abbreviations:

LS = Leaf spot resistance; BR = black root resistance; MM = multigerm; mm = monogerm; PC = polycross; Syn = Synthetic variety; Sib = increase single progeny; W.C. = production numbers of West Coast Beet Seed Company

Variety Number	Description
1. Acc. 1378	W.C. 6200 Narrow base MM Syn. from selfed seed of outstanding PC mother best
2. SP 5611-0	Broader base MM Syn. " " " " " "
3. Acc. 1379	Broad " " " from selfed seed of yield type PC mother best
4. Acc. 1380	W.C. 6327, increase of W.C. 5215. increase from progeny S.P. 53AB1-65. Especially good in LS.
5. Acc. 1382	W.C. 6319-W.C. 5214. MM variety
6. Acc. 1394	W.C. 6315. Michigan selection related to Acc. 1382
7. Acc. 1395	W.C. 6302. U.S. 401
8. Acc. 1396	50-50 mixture of mm hybrids using 2 different pollinators
9. Acc. 1397	Same as Acc. 1396, but using a different mm MS female line
10. Acc. 1381	W.C. 6202. Mass-selected MM variety
11. Acc. 1391	W.C. 4441. U.S. 400
12. Acc. 1368	W.C. 5351. mm hybrid. (SLC 610 x 91MS) x U.S. 400
13. Acc. 2058	W.C. 5301. U.S. 225MS x U.S. 401
14. SP 56400-01	PC selected self-sterile MM variety
15. SP 454-01	" " " " " "
16. 345s55M2	H.L. Kohl's MM variety
17. SP 5621-01	SP 5520-03 MS mm x LS-BR-MM selected roots in PC plot
18. SP 5622-00	SP 5520- MS mm x " " " " " " " "
19. SP 5624-01	SP 5520-05 " " " " " " " " " "
20. SP 5625-01	SP 5520-07 " " " " " " " " " "
21. SP 5626-01	SP 5515-02 " " " " " " " " " "
22. 5627-00	SP 5515-03 & 04 MS mm x LS-BR-MM selected roots in PC plot
23. 5628-01	SP 5515-05 MS mm x LS-BR-MM selected roots in PC plot
24. 5629-00	SP 5515-06 & -08 MS mm x LS-BR-MM selected roots in PC plot
25. 5630-01	SP 5515-07 " " " " " " " " " "
26. 5632-01	SP 5515-09 " " " " " " " " " "
27. 5633-01	SP 5515-010 " " " " " " " " " "
28. Acc. 1384	W.C. 6204F mm hybrid. 5520-01 MS mm x SP 5460-0
29. Acc. 1385	W.C. 6206F " " 5515-01 " " " U.S. 401
30. U-I	(610 x 91 x 108) MS x SP 5460-0 mm hybrid
31. U-I	(610 x 91 x 108) MS x U.S. 401 mm hybrid
32. U-I	(610 x 91 x 110) MS x SP.5640-0 mm hybrid
33. Acc. 1392	W.C. 5354. U.S. 401
34. Acc. 1393	W.C. 6310. U.S. 401 (Stock)
35. Acc. 1387	SL 91 MS mm x 5460-0. mm hybrid
36. Acc. 1388	SL 91 MS mm x U.S. 401 mm hybrid

Summary Table 4.--Acre-yield of gross sugar and of root and sucrose percentage of new breeder seed and monogerm hybrids in agronomic tests conducted at Saginaw, Mich., and Pandora, Ohio. Data are given as 5-plot averages at Saginaw and 6-plot averages at Pandora. For individual tests, see pages 154 and 156.

Entry No.	Gross Sugar			Tons of Roots			Sucrose Percentage		
	Saginaw Mich.	Pandora Ohio	Average	Saginaw Mich.	Pandora Ohio	Average	Saginaw Mich.	Pandora Ohio	Average
	Pounds	Pounds	Pounds	Tons	Tons	Tons	%	%	%
Acc. 1378	6165	8570	7368	17.48	31.59	24.54	17.65	13.60	15.63
SP 5611-0	5613	8443	7028	15.99	30.89	23.44	17.60	13.72	15.66
Acc. 1379	5423	8788	7106	15.30	32.64	23.97	17.73	13.49	15.61
Acc. 1380	5288	8899	7094	14.74	32.12	23.43	17.92	13.88	15.90
Acc. 1382	5823	9251	7537	16.82	33.90	25.36	17.34	13.64	15.49
Acc. 1394	5367	8573	6970	15.21	31.95	23.58	17.67	13.47	15.57
Acc. 1395	5897	8156	7027	17.63	31.53	24.58	16.76	12.94	14.85
Acc. 1396	5642	8255	6949	15.77	31.92	23.85	17.86	12.93	15.40
Acc. 1397	5742	9126	7434	15.44	32.43	23.94	18.60	14.08	16.34
Acc. 1381	5604	8679	7142	16.23	33.78	25.01	17.26	12.80	15.03
Acc. 1391	5032	8864	6948	14.64	33.30	23.97	17.19	13.32	15.26
Acc. 1368	5169	7553	6361	14.52	29.15	21.84	17.82	13.09	15.46
Acc. 2058	5847	9554	7701	16.63	35.99	26.31	17.61	13.28	15.45
SP 56400-01	6164	8962	7563	17.61	34.90	26.26	17.49	12.86	15.18
SP 56454-01	6235	8581	7408	18.08	32.99	25.54	17.25	13.04	15.15
345s-55M-2	5555	7560	6558	16.61	30.89	23.75	16.74	12.25	14.50
SP 5621-01	5924	9460	7692	16.11	33.69	24.90	18.39	14.06	16.23
SP 5622-00	6102	9631	7867	17.18	34.64	25.91	17.77	13.91	15.84
SP 5624-01	5845	9054	7450	16.15	31.18	23.67	18.10	14.50	16.30
SP 5625-01	6344	10053	8199	17.60	35.32	26.46	18.03	14.25	16.14
SP 5626-01	5876	9244	7560	16.28	33.55	24.92	18.03	13.75	15.89
SP 5627-00	5767	9263	7515	16.08	33.66	24.87	17.95	13.77	15.86
SP 5628-01	5962	9512	7737	16.65	35.75	26.20	17.92	13.38	15.65
SP 5629-00	6331	9585	7958	17.25	34.09	25.67	18.36	14.11	16.24
SP 5630-01	6104	9623	7864	17.24	35.99	26.62	17.72	13.39	15.56
SP 5632-01	5865	9022	7444	16.51	33.23	24.87	17.78	13.63	15.71
SP 5633-01	4655	7085	5870	13.50	26.55	20.03	17.23	13.33	15.28
Acc. 1384	6191	9533	7862	16.70	34.38	25.54	18.59	13.94	16.27
Acc. 1385	5526	8340	6933	15.82	31.71	23.77	17.46	13.14	15.30
U & I hybrid	5728	8511	7120	15.95	32.46	24.21	17.92	13.17	15.55
U & I hybrid	5803	7600	6702	16.51	28.99	22.75	17.57	13.18	15.38
U & I hybrid	5644	8084	6864	15.66	29.73	22.70	18.04	13.68	15.86
Acc. 1392	5695	8153	6924	16.96	31.33	24.15	16.79	13.03	14.91
Acc. 1393	5939	8171	7055	18.22	31.43	24.83	16.35	13.05	14.70
SP 561812-00	6271	8537	7404	17.70	32.20	24.95	17.71	13.33	15.52
SP 561813-00	5718	8959	7339	16.41	34.35	25.38	17.47	13.03	15.25

PART VIII

FIELD EVALUATION

of

BREEDER SEED OF SYNTHETIC VARIETIES

ARISING IN BREEDING PROGRAM TO COMBINE RESISTANCE

(1) TO LEAF SPOT AND CURLY TOP

(2) TO LEAF SPOT AND BLACK ROOT

and

MISCELLANEOUS VARIETIES, INCLUDING MONOGERM HYBRIDS

Supported under Foundation Project 26

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Cooperators Conducting Field Tests:

Farmers and Manufacturers Beet Sugar Association
Great Western Sugar Company
New Mexico Agricultural Experiment Station

Field Evaluation of Varieties Arising in Breeding to Combine Resistances to Leaf Spot, Curly Top, and Black Root

The results of eight tests are reported in Summary Tables 1, 2, and 3 of this part of the report. The variety descriptions are given on Page 162. The results of tests conducted by Spreckels Sugar Company with U.S. 104 have been given on Page 59.

The test at the New Mexico Agricultural Experiment Station, State College, New Mexico, was conducted under severe curly top exposure. All other tests reported in Summary Tables 1, 2, and 3 were conducted without curly top being a factor in the relative performance of the varieties. The test under the sprinkler system at Fort Collins, Colorado, gives the relative performance of the varieties grown under severe leaf spot exposure. This test at Fort Collins and the test at State College, New Mexico, will serve to give the relative disease reaction of the varieties.

A study of the relative performance of the varieties developed to combine resistance to leaf spot and curly top indicates that progress is being made in this direction of breeding. Acc. 1370, which is a reselection through polycross progenies from U.S. 104, has probably given the best performance. This new synthetic has shown leaf spot resistance essentially equal to U.S. 401, and its curly top resistance approaches that of SLC 202H-9. However, under severe curly top exposure at State College, New Mexico, this variety is not as productive as the hybrid produced at Salt Lake City.

Field Tests Conducted at

Saginaw, Michigan, and Pandora, Ohio

Description of Breeders Seed arising in a program of breeding to combine resistances to leaf spot and curly top and also black root. The European varieties are not part of this breeding program.

The direction and history of breeding have been indicated below, using the following abbreviations:

LS = Leaf spot resistance; BR = black root resistance; CT = curly top resistance; MS = male sterility; MM = multigerm; mm = monogerm; PC = polycross progeny; W.C. = production number of West Coast Beet Seed Company

Seed No.	Description
1. Acc. 1327	W.C. 3216 increase of 486-0. Pool of 9 European brands
2. Acc. 1370	U-I 56-124 " " 55104-0. LS-CT-BR-MM Syn. from clones of outstanding LS PC mother beets
3. Acc. 1371	U-I 56-125 increase 5550-0. LS-CT-BR-MM PC mass selected
4. Acc. 1372	U-I 56-126 increase 5552-0. LS-CT-BR-MM mass selected
5. Acc. 1373	SLC 202 H7 CT 9 ms hybrid x (US. 35 x US. 22/4) CT-MM hybrid
6. Acc. 1374	F 54-4H7 CT 9 ms hybrid x (U.S. 35aa x Klein E) CT-MM hybrid
7. Acc. 1375	W.C. 6305 UIB/1 (610 x 91 MS mm) x (U.S. 35aa x CT9) CT-MM hybrid
8. Acc. 1376	C 663H1 (McF) (MS of NB1 x NB3) x 663. NB-CT-MM hybrid
9. Acc. 1377	F 56-66H2 (McF) (MS of NB1 x NB2) x 366. NB-MM hybrid
10. Acc. 1378	W.C. 6200 Inc. SP 5510 LS-BR-MM Syn. from selfed PC mother
11. Acc. 1380	W.C. 6327, Increase W.C. 5215, increase of progeny SP 53AB1-65 LS-BR-MM. Good in LS
12. Acc. 1382	W.C. 6319--Inc. W.C. 5214. LS-BR-MM variety
13. Acc. 1395	W.C. 6302. U.S. 401.
14. SL 6932	91 MS mm x 4n U.S. 35. Triploid CT mm hybrid
15. U-I Hyb. 5550-0	(610 x 91 x 108) MS mm x SP 5550-0
16. U-I Hyb. 824aa	(610 x 91 x 108) MS mm x (824aa x SP 491001-0)
17. Kohls 345 Hyb.	
18. Acc. 1396	50-50 mixture. 5515-01 MS mm x SP 5460-0 & 5515-01 MS mm x U.S. 401
19. Acc. 1397	50-50 mixture. 5520-01 MS mm x SP 5460-0 & 5520-01 MS mm x U.S. 401
20. Acc. 2057	W.C. 5354. U.S. 401.
21. Acc. 2073	G.W. 359
22. Hilleshog Standard	European
23. Hilleshog R	European
24. Maribo	European
25. Zwaanesse	European
26. Bro Type B	European

Summary Table.1.--Acre-yield of gross sugar in agronomic tests conducted to evaluate Breeder Seed arising in breeding to combine resistance to leaf spot and curly top, to leaf spot and black root, and miscellaneous entries. For details concerning tests, see pages 166-181.

Variety	Saginaw, Mich.	Pandora, Ohio	Ft. Collins, Colo. (w/sprinkler)	Ft. Collins, Colo. (Bachmayr)	Longmont, Colo.	Ft. Morgan, Colo.	Gering, Nebr.
Acc. 1327	4645	5340	1702	8284			
Acc. 1370	5768	6664	1764	7031	5615	4649	7513
Acc. 1371	5157	6205	1551	6808	5170	4557	6981
Acc. 1372	5266	6450	1781	6837	5418	4880	6793
Acc. 1373	5219	5533	1991	8670			
Acc. 1374	5275	5689	1904	8279			
Acc. 1375	4672	5586	1813	7548			
Acc. 1376	4840	5762	1815	8406			
Acc. 1377	4717	6364	1902	8086			
Acc. 1378	6361	8137	2215	7453	5092	5356	7835
Acc. 1380			1967	6880	4211	4727	7155
Acc. 1382	5646	8109	2032	7098	5122	5107	7569
Acc. 1395	5712	7521					
SL 6932	5313						
U-I Hyb. (5550-0)	5653	6712					
U-I Hyb. (824aa)	5236	6106					
Kohls 345 Hyb.		6874					
Acc. 1396			1926	6540			
Acc. 1397			1988	6288			
Acc. 2057			2007	6706			
Acc. 2073			2527	7665			
Hilleshog Standard	5381	5473					
Hilleshog R	5088	5735					
Maribo	5118	5122					
Zwaanesse	4275	6101					
Bro Type B	4586	5358					
GW 359-53R					6456	5780	7559
LSD .05	669	740	220	262	510	430	351

—For additional tests see pages 32 and 59

Summary Table 2.--Acre-yield of roots in agronomic tests conducted to evaluate Breeder Seed arising in breeding to combine resistance to leaf spot and curly top, and leaf spot and black root resistance, and miscellaneous entries. For details concerning tests, see pages 166-181.

Variety	Saginaw, Mich.	Pandora, Ohio	Ft. Collins, Colo. (w/sprinkler)	Ft. Collins, Colo. (Bachmayr)	Longmont, Colo.	Ft. Morgan, Colo.	Gering, Nebr.	St. College, N. Mex.
Acc. 1327	14.26	23.25	7.17	24.27				
Acc. 1370	18.01	27.27	7.14	22.41	18.78	14.62	22.11	26.83
Acc. 1371	15.92	26.14	6.31	20.53	17.43	14.10	20.13	27.06
Acc. 1372	16.01	27.41	7.40	21.94	18.97	15.66	19.43	25.98
Acc. 1373	16.64	24.02	7.96	25.65				
Acc. 1374	16.02	24.59	7.79	25.05				
Acc. 1375	13.71	23.81	6.96	21.94				
Acc. 1376	15.13	25.03	7.35	24.90				
Acc. 1377	14.58	25.71	7.53	22.71				
Acc. 1378	18.99	29.91	8.43	22.54	17.32	16.20	22.22	
Acc. 1380			7.50	21.52	14.88	14.80	20.27	
Acc. 1382	16.87	31.45	7.76	21.95	17.71	15.85	21.94	
Acc. 1395	16.83	30.32						
SL 6932	16.28							
U-I Hyb. (5550-0)	16.58	26.98						
U-I Hyb. (824aa)	15.07	25.90						
Kohls 345 Hyb.		29.26						
Acc. 1396			7.53	19.43				
Acc. 1397			7.44	18.99				
Acc. 2057			7.84	21.05				
Acc. 2073			9.55	22.98				
Hilleshog Standard	17.00	24.36						
Hilleshog R	16.35	26.11						
Maribo	16.45	21.73						
Zwaanesse	14.16	27.12						
Bro Type B	16.06	26.08						
SLC 333								18.48
SLC 202 H-9								31.68
SLC 509 H-6								30.53
F 55-92								26.96
SP 5654-0								27.67
GW 359-53R					20.56	18.03	21.61	
LSD .05	1.77	2.53	0.73	0.75	1.38	1.23	0.94	3.84

For additional tests see pages 32 and 69

Summary Table 3.--Sucrose percentages in agronomic tests conducted to evaluate Breeder Seed arising in breeding to combine resistance to leaf spot and curly top, and leaf spot and black root resistance, and miscellaneous entries. For details concerning tests see pages 166-181.

Variety	Saginaw, Mich.	Pandora, Ohio	Ft. Collins, Colo. (w/sprinkler)	Ft. Collins, Colo. (Bachmayr)	Longmont, Colo.	Ft. Morgan, Colo.	Gering, Nebr.
Acc. 1327	16.27	11.46	11.88	17.10			
Acc. 1370	16.06	12.23	12.33	15.72	14.95	15.90	16.99
Acc. 1371	16.17	11.88	12.31	16.58	14.83	16.16	17.34
Acc. 1372	16.43	11.71	11.98	15.59	14.28	15.58	17.48
Acc. 1373	15.68	11.52	12.46	16.91			
Acc. 1374	16.44	11.60	12.25	16.53			
Acc. 1375	17.05	11.75	13.03	17.21			
Acc. 1376	15.97	11.53	12.35	16.88			
Acc. 1377	16.17	12.37	12.65	17.84			
Acc. 1378	16.74	13.62	13.13	16.54	14.70	16.53	17.63
Acc. 1380			13.10	15.99	14.15	15.97	17.65
Acc. 1382	16.72	12.87	13.09	16.18	14.46	16.11	17.25
Acc. 1395	16.97	12.42					
SL 6932	16.30						
U-I Hyb. (5550-0)	17.02	12.40					
U-I Hyb. (824aa)	17.38	11.79					
Kohls 345 Hyb.		11.78					
Acc. 1396			12.80	16.83			
Acc. 1397			13.35	16.55			
Acc. 2057			12.83	15.95			
Acc. 2073			13.22	16.68			
Hilleshog Standard.	15.79	11.24					
Hilleshog R	15.59	11.00					
Maribo	15.52	11.73					
Zwaanesse	15.08	11.21					
Bro Type E	14.29	10.33					
SW 359-53R					15.70	16.03	17.49
LSD .05	0.73	0.76	0.63	0.62	0.70	0.44	0.29

AGRONOMIC EVALUATION TEST- 1957

Conducted by: M. R. Berrett, P. A. Reeve.

Location: Elmer Rader farm, Saginaw, Michigan.

Cooperation: F. & M. Beet Sugar Assoc.

Date of Planting: May 4.

Date of Harvest: October 11.

Experimental Design: 6 x 6 Triple Lattice, 4 x 5 Rectangular Lattice,

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: 6 rows x 18 feet, hand topped.

Samples for Sucrose Determinations: one 10-beet sample of consecutive beets from each of the outside harvested rows.

Stand and Bolter Counts: Harvested beets counted when weighed. In the 6 x 6 set of varieties, Entry # 27, 5633-01, almost one third of the plants of this variety bolted. Afew other varieties showed an occasional bolter.

Recent Field History: 1956- alfalfa plowed down in June, 1955- oats seeded to alfalfa, 300# 5-20-20, 1954- beets- 500 # 5-20-20.

Fertilization of Beet Crop: 400 # 6-24-12.

Leaf Spot Exposure: Moderate.

Black Root Exposure: Light, in seedling stage.

Other Diseases and Pests:

Soil and Seasonal Conditions: Dry seed bed. Heavy rains in July. Moisture adequate balance of season. Flood waters from the river drowned out several plots in the sixth replication of the 6 x 6 . Records from the remaining plots of this replication were omitted from the summary.

Reliability of Test: Excellent.

Cooperator: F. & M. Beet Sugar Association. Year: 1957

Location: Elmer Rader farm, Saginaw, Michigan. Expt. 20-1

Variety and Description		Acre-Yields Gross Sugar	Acre-Yields Roots	Sucrose	Beets per 100' of row
		Pounds	Tons	Percent	Number
Acc 1370 55104-0	LS-CT-MM PC Syn	5768	18.01	16.06	98
Acc 1371 5550-0	LS-CT-MM	5157	15.92	16.17	[illegible]
Acc 1372 5552-0	LS-CT-MM	5266	16.01	16.43	82
Acc 1373 SLC 202H7 CT9 MShyb X (US35xUS22/4)	CT-MM hybrid	5219	16.64	15.68	[illegible]
Acc 1374 F54-4H7 CT9 MShyb X (US35aa x Klein E)	CT-MM hybrid	5275	16.02	16.44	[illegible]
Acc 1375 UI E/1 (610x91MSmm)X(US35aa X CT9)	CT-MM hybrid	4672	13.71	17.05	81
Acc 1376 C663H1 (MS of NB1xNB3) X 663	NB-CT-MM hybrid	4840	15.13	15.97	77
Acc 1377 F56-66H2 (MS of NB1xNB2) X 366	NB MM hybrid	4717	14.58	16.17	77
Acc 1327 486-0 Syn.Ck. 9 European Vars.	MM	4645	14.26	16.27	88
Hilleshog Standard Polyploid	MM	5381	17.00	15.79	87
Hilleshog R Polyploid	MM	5088	16.35	15.59	89
Maribo Polyploid	MM	5118	16.45	15.52	79
Zwaanesse Diploid	MM	4275	14.16	15.08	74
Ero Type E	MM	4586	16.06	14.29	68
U-I (610x91x108)MS X 5550-0	mm hybrid	5653	16.58	17.02	101
U-I (610x91x108)MS X 824aa X 491001-0mm		5236	15.07	17.38	89
Acc 1378 5510-0	LS-BR-MM PC Syn	6361	18.99	16.74	92
Acc 1382 5481-0	LS-BR-MM PC	5646	16.87	16.72	92
Acc 1395 US 401 Stock	LS-BR-MM PC mass sel	5712	16.83	16.97	107
SL 6932 91MS mm X 4n US35	CT-mm hyb	5313	16.28	16.30	81
General Mean		5196	16.04	16.18	86
S. E. Variety Mean		238	.63	.26	5
" " " as % of Gen. Mean		4.58	3.93	1.61	5.81
Diff. req. for sig. (Odds 19:1)		669	1.77	.73	15

Variance Table

Random Block analysis

Source of variation	D/F a/	Mean Squares Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	1,310,992	12.4207	3.2802	388
Between varieties	19	1,451,959	10.0388	3.2554	566
Remainder-Error	95	341,344	2.4011	.4071	178
Total	119				
Calculated F value b/		4.25**	4.18**	8.00**	3.18**

a/ D/F for Gross Sugar and Roots should be 5,19,93,117 resp. - 2 missing plots.

b/ ** F value significant at 1 % level.

AGRONOMIC EVALUATION TEST- 1957

Conducted by: H. W. Bockstahler, G. J. Hogaboam.

Location: Louis Risser,Jr. farm, Pandora, Ohio .

Cooperation: F. & M. Beet Sugar Assoc. and Buckeye Sugars,Inc.

Date of Planting: May 1 & 2.

Date of Harvest: November 6-13.

Experimental Design: 6 x 6 Triple Lattice, 4 x 5 Rectangular Lattice, 6 replications each.

Size of Plots: 8 rows x 20 feet, 28" rows.

Harvested Area per Plot for Root Yield: 6 rows x 17 feet, machine harvested-Marbeet Jr. harvester. All plot numbers ending in 3 and 4 - four rows x 17 feet. For analysis, yields were converted to six row basis. Rains during harvest period prevented completion of yield records. Acre yields for these two experiments were exceptionally high due to mud clinging to the beets and in the weighing tubs, however, the relative ranking of the varieties should be acceptible. US 401,surrounding test plots,harvested earlier, yielded 23 tons per acre.

Samples for Sugar Determinations: One 10-beet sample from each of two rows from each plot. Picked from tub after weighing. Excess beets over ten discarded. All plots ending in 3 - one sample per plot.

Stand and Bolter Counts: Beets counted from tubs after weighing. Beets missed by harvester gleaned immediately behind machine. In the 6 x 6 set of varieties, Entry # 27, 5633-01, showed almost one third of the plants bolted. A few other varieties showed an occoasional bolter.

Recent Field History: 1946-56 pasture. 1953-56 50# N /A. each year. 1952- 1000# rock phosphate/A. 1945- Wheat. 1900 ?-45 pasture.

Fertilization of Beet Crop: 222 # 11-48-0 with .75 % Thiram

Leaf Spot Exposure: Severe in 4 x 5 , Moderate in 6 x 6. Field had never grown beets previously.

Black Root Exposure: None.

Other Diseases and Pests: None.

Soil and Seasonal Conditions: Seed bed moist. Moisture adequate entire season.

Reliability of Test: Good.

Cooperator: F. & M. Beet Sugar Assoc., Buckeye Sugars, Inc. Year: 1957

Location: Louis Risser, Jr. farm, Pandora, Ohio. Expt. 20-2

(Results given as 6 plot averages)

Variety and Description	Acre-Yields Gross Sugar	Acre-Yields Roots	Sucrose	Beets per 100' of row	Leaf Spot 9-4-57
	Pounds	Tons	Percent	Number	Rating
Acc 1370 55104-0 LS-CT-MM PC Syn.	6664	27.27	12.23	90	4.7
Acc 1371 5550-0 LS-CT-MM	6205	26.14	11.88	85	4.5
Acc 1372 5552-0 LS-CT-MM	6450	27.41	11.71	78	5.2
Acc 1373 SLC 202H7 CT-MM hybrid	5533	24.02	11.52	97	6.3
CT9 MShyb X (US35xUS22/4)					
Acc 1374 F54-4H7 CT-MM hybrid	5689	24.59	11.60	84	6.3
CT9 MShyb X (US35aa x Klein E)					
Acc 1375 UI E/1 CT-MM hybrid	5586	23.81	11.75	88	6.0
(610x91MSmm)X(US35aa X CT9)					
Acc 1376 C663H1 NB-CT-MM hybrid	5762	25.03	11.53	86	6.0
(MS of NB1xNB3) X 663					
Acc 1377 F56-66H2 NB MM hybrid	6364	25.71	12.37	87	6.2
(MS of NB1xNB2) X 366					
Acc 1327 486-0 Syn. Ck. 9 European Vars. MM	5340	23.25	11.46	85	6.2
Hilleshog Standard Polyploid MM	5473	24.36	11.24	79	6.3
Hilleshog R Polyploid MM	5735	26.11	11.00	86	6.0
Maribo Polyploid MM	5122	21.73	11.73	83	6.8
Zwaanesse Diploid MM	6101	27.12	11.21	92	6.2
Ero Type E MM	5358	26.08	10.33	92	6.8
U-I (610x91x108)MS X 5550-0 mm hyb	6712	26.98	12.40	91	5.2
U-I (610x91x108)MS X(824aaX 491001-0)mm	6106	25.90	11.79	88	5.3
Acc 1378 5510-0 LS-BR-MM PC Syn.	8137	29.91	13.62	94	3.8
Acc 1382 5481-0 LS-BR-MM PC	8109	31.45	12.87	87	3.5
Acc 1395 US 401 Stock LS-BR-MM PC ~~mass~~ sel	7521	30.32	12.42	83	4.5
Kohls 345s56EL-1 LS-BR-MM	6874	29.26	11.78	72	4.3
General Mean	6242	26.32	11.82	86	
S. E. Variety Mean	264	.90	.27	3	
" " " as % of Gen. Mean	4.23	3.41	2.28	3.49	
Diff. req. for sig. (Odds 19:1)	740	2.53	.76	8	

Variance Table

Random Block analysis

Source of variation	D/F	Mean Squares Gross Sugar	Roots	Sucrose	Beets per 100' row
Between replications	5	4,066,782	75.6013	1.1048	99
Between varieties	19	4,666,196	37.3371	2.9877	204
Remainder-Error	95	417,053	4.8623	.4402	51
Total	119				
Calculated F value a/		11.19**	7.68**	6.79**	4.00**

a/ ** F value significant at 1 % level.

AGRONOMIC EVALUATION TEST

Conducted by: H. E. Brewbaker and H. L. Bush

Location: Great Western Sugar Company Experiment Station, Longmont, Colorado

Cooperation: Great Western Sugar Company

Date of Planting: March 28, 1957

Date of Harvest: October 17, 18, 1957

Experimental Design: Triple Lattice

Size of Plots: 6 rows x 22 feet planted (22 inch rows)

Harvested Area per Plot for Root Yield: 6 rows x 18 feet

Samples for Sucrose Determinations: 2 samples per plot, each 1 row x 18 feet

Stand and Bolter Counts: Bolters counted August 29
Beets counted in laboratory for stand

Recent Field History: 1955 fallow, 1956 corn fall plowed

Fertilization of Beet Crop: 150 lbs. per A. ammonium nitrate and
150 lbs. per A. treble super-phosphate plowed under

Leaf Spot Exposure: Very mild and spotty. Not severe enough for readings.

Black Root Exposure: None noted

Curly Top Exposure: None noted

Other Diseases: Virus yellows varied from quite severe to only slight effect.

Soil and Seasonal Conditions: Snow and cold for about 3 weeks early in April contributed to development of many bolters. Soil fertility good but somewhat variable.

Cooperator: Great Western Sugar Company by H. E. Brewbaker and H. L. Bush Year: 1957

Location: Great Western Sugar Company Experiment Station, Longmont, Colorado

(Results given as 9 plot averages)

Variety	Acre Yield Sugar Recoverable[a] (lbs.)	Acre Yield Sugar Gross (lbs.)	Acre Yield Roots (tons)	Sucrose (%)	Thin Juice App. Purity (%)	Top[d] Vigor	Bolters (%)	Beets per 100 ft. (No.)
GW359-53R	5560	6456	20.56	15.70	93.25	2.4	4.49	106
Acc. 1370	4854	5615	18.78	14.95	93.45	3.8	0.94	107
Acc. 1372	4614	5418	18.97	14.28	92.80	3.0	0.58	113
Acc. 1371	4420	5170	17.43	14.83	92.95	3.9	0.14	105
Acc. 1382	4265	5122	17.71	14.46	91.81	2.3	5.72	105
Acc. 1378	4245	5092	17.32	14.70	91.86	3.0	8.77	106
Acc. 1380	3441	4211	14.88	14.15	91.04	3.0	6.23	103
General Mean[e]	5232	6106	19.62	15.56	92.85	2.6	2.45	107
S.E. Variety Mean	-	168.05	.4490	.2377	.3972	-	-	-
S.E. Variety Mean as % of Gen. Mean	-	2.75	2.29	1.53	0.43	-	-	-
Diff. req. for Sig. (Odds 19:1)	437[b]	510	1.38	0.70	1.19	-	-	-

Variance Table

Source of Variation	DF	Mean Squares: Gross Sugar[c] (lbs.)	Roots (tons)	Sucrose (%)	Purity (%)
Replicates	8	-	14.1655	12.8188	36.3125
Component (a)	24	-	15.0010	1.1783	4.3308
Component (b)	12	-	17.3927	3.2325	8.1508
Blocks (elim. var.)	36	-	15.7982	1.8631	5.6042
Var. (ignor blocks)	24	-	30.7069	3.7208	6.1896
Error (Intra-block)	156	-	1.8142[f]	.5085[f]	1.4199[f]
Error (Random Block)	192	-	4.4362	.7624	2.2044
Total	224	-	7.5984	1.5100	3.8496
Calculated F Value	-	-	16.93**	7.32**	4.36**

(a, (b, (c See attached sheet for footnotes. on page 17

(d 1 = extremely large tops, 10 = very small tops.

(e General mean for 25 varieties in entire test.

(f Error term used.

AGRONOMIC EVALUATION TEST

Conducted by: H. E. Brewbaker and H. L. Bush

Location: William Kroskob Farm, Fort Morgan, Colorado

Cooperation: Great Western Sugar Company

Date of Planting: April 25, 1957

Date of Harvest: October 23, 24, 1957

Experimental Design: Triple Lattice

Size of Plots: 6 rows x 22 feet planted (22 inch rows)

Harvest Area per Plot for Root Yield: 6 rows x 18 feet

Samples for Sucrose Determination: 2 samples per plot, each 1 row x 18 feet

Stand and Bolter Counts: Bolters counted October 22
Beets counted in laboratory for stand

Recent Field History: 1955 alfalfa, 1956 potatoes fall plowed

Fertilization of Beet Crop: 15 tons manure per acre plowed under
150 pounds per acre 12-24-0 broadcast before planting.

Leaf Spot Exposure: Very mild on susceptible varieties in late August with no later development.

Black Root Exposure: None noted

Curly Top Exposure: None noted

Other Diseases: Some root-knot nematode in field

Soil and Seasonal Conditions: Rather late planted due to spring storms but growth was good after starting. Soil rather variable in replicates 1 and 2 while replicate 9 suffered from flooding.

Cooperator: Great Western Sugar Company by H. E. Brewbaker and H. L. Bush Year: 1957

Location: William Kroskob Farm, Fort Morgan, Colorado

(Results given [redacted] 9 plot averages)

Variety	Acre Yield: Sugar: Recoverable[a] (lbs.)	Acre Yield: Sugar: Gross (lbs.)	Acre Yield: Roots (tons)	Sucrose (%)	Thin Juice App. Purity (%)	Bolters (%)	Beets per 100 ft. (No.)
GW359-53R	5033	5780	18.03	16.03	93.73	0.00	116
Acc. 1378	4681	5356	16.20	16.53	93.87	0.76	109
Acc. 1382	4499	5107	15.85	16.11	94.29	0.76	111
Acc. 1372	4284	4880	15.66	15.58	94.15	0.00	114
Acc. 1380	4080	4727	14.80	15.97	93.32	0.00	109
Acc. 1370	4054	4649	14.62	15.90	93.80	0.00	107
Acc. 1371	4016	4557	14.10	16.16	94.30	0.00	107
General Mean[d]	4745	5412	16.41	16.49	93.98	0.09	111
S.E. Variety Mean	-	145.31	.4164	.1451	.2745	-	-
S.E. Variety Mean as % of Gen. Mean	-	2.68	2.54	0.88	0.29	-	-
Diff. req. for Sig. (Odds 19:1)	377[b]	430	1.23	0.44	0.82	-	-

Variance Table

Source of Variation	DF	Mean Squares: Gross Sugar[c] (lbs.)	Mean Squares: Roots (tons)	Mean Squares: Sucrose (%)	Mean Squares: Purity (%)
Replicates	8	-	89.4891	39.2713	79.0850
Component (a)	24	-	3.5475	.9363	1.9625
Component (b)	12	-	3.7327	.5642	2.0217
Blocks (elim. var.)	36	-	3.6092	.8122	1.9822
Var. (ignor. block)	24	-	11.2728	.2420	3.3192
Error (Intra-block)	156	-	1.5607[e]	.1896[e]	.6783[e]
Error (Random Block)	192	-	1.9967	.3064	.9227
Total	224	-	6.2094	1.9244	3.9711
Calculated F Value	-	-	7.22**	NS	4.89**

(a, (b, (c See attached sheet for footnotes, on page

(d General mean for 25 varieties in entire test.

(e Error term used.

AGRONOMIC EVALUATION TEST

Conducted by: H. E. Brewbaker and H. L. Bush

Location: J. R. Gross Farm, Gering, Nebraska

Cooperation: Great Western Sugar Company

Date of Planting: April 24, 1957

Date of Harvest: October 27, 28, 29, 1957

Experimental Design: Triple Lattice

Size of Plots: 6 rows x 22 feet planted (22 inch rows)

Harvested Area per Plot for Root Yield: 6 rows x 18 feet

Sample for Sucrose Determinations: 2 samples per plot, each 1 row x 18 feet

Stand and Bolter Counts: Bolters counted October 26.
Beets counted in laboratory for stand.

Recent Field History: 1956 corn, spring plowed 1957

Fertilization of Beet Crop: 12 tons per acre manure plowed under
150 pounds per acre 12-24-0 side dressed at planting time.

Leaf Spot Exposure: None noted

Black Root Exposure: None noted

Curly Top Exposure: None noted

Other Diseases: Some few beets were noted as dying from Rhizoctonia expecially in replicates 1, 2, 3 and 4.

Soil and Seasonal Conditions: Rather late planted due to April storms but beets grew nicely after started. Subjected to 3 rather severe floods but no stand damage resulted.

Cooperator: Great Western Sugar Company by H. E. Brewbaker and H. L. Bush Year: 1957

Location: J. R. Gross Farm, Gering, Nebraska

(Results given as 9 plot averages)

Variety	Acre Yield Sugar Recoverable[a] (lbs.)	Acre Yield Sugar Gross (lbs.)	Acre Yield Roots (tons)	Sucrose (%)	Thin Juice App. Purity (%)	Bolters (%)	Beets per 100 ft. (No.)
Acc. 1378	6961	7835	22.22	17.63	94.60	0.23	116
Acc. 1382	6750	7569	21.94	17.25	94.78	1.74	119
GW359-53R	6745	7559	21.61	17.49	94.81	0.08	119
Acc. 1370	6683	7513	22.11	16.99	94.69	0.00	122
Acc. 1380	6408	7155	20.27	17.65	94.99	0.61	116
Acc. 1371	6275	6981	20.13	17.34	95.17	0.00	112
Acc. 1372	6097	6793	19.43	17.48	95.10	0.23	101
General Mean[d]	6699	7505	21.32	17.60	94.82	0.23	115
S.E. Variety Mean	-	123.05	.3292	.0975	.1775	-	-
S.E. Variety Mean as % of Gen. Mean	-	1.64	1.54	0.55	0.19	-	-
Diff. req. for Sig. (Odds 19:1)	313[b]	351	0.94	0.29	0.50	-	-

Variance Table

Source of Variation	DF		Mean Squares: Gross Sugar[c] (lbs.)	Roots (tons)	Sucrose (%)	Purity (%)
Replicates	8		-	3.9275	.1901	5.5438
Component (a)		24	-	1.2398	.1788	.2967
Component (b)		12	-	1.5391	.4333	.4267
Blocks (elim. var.)	36		-	1.3396	.2636	.3400
Var. (ignor blocks)	24		-	7.0474	.9229	1.9608
Error (Intra-block)	156		-	.9756[e]	.0856[e]	.2836[e]
Error (Random Block)	192		-	1.0439	.1190	.2942
Total	224		-	1.7901	.2688	.6602
Calculated F Value	-		-	7.22**	10.78**	6.91**

(a,(b,(c See attached sheet for footnotes, on page 176

(d General mean for 25 varieties in entire test.

(e Error term used.

Technique used for Recoverable Sugar*

H. E. Brewbaker and H. L. Bush

(a **Recoverable Sugar**

A technique, whereby thin juice purity could be determined from small samples was first used in 1953, following methods recently developed in the G.W. Research Laboratory at Denver. Using the resultant purity figure, a calculated "Recoverable Sugar" is obtained. An example of the calculation is as follows:

Sugar in beets = 12.00%
Standard total losses = 0.30%
Sugar on beets at sugar end = 12.00 - 0.30 = 11.70%

Assume standard molasses purity = 62.5%
100.0 - 62.5 = 37.5% Impurities on solids in molasses
$\frac{62.5}{37.5}$ = 1.6667% Sugar on impurities in molasses

Sugar sacked
85% purity thin juice = 15% impurities
$\frac{15}{85}$ = 17.6471% impurities on sugar

Sugar end = 11.70 x 17.6471% = 2.064171% on beets
Molasses produced = 2.06471 x 1.66667 = 3.4413% on beets
Sugar sacked = 12.00 - (0.30 + 3.4413) = 8.2587%

Recoverable sugar = $\frac{8.2587}{12.00}$ = 68.82%

(b **Approximation** - Calculated as percentage of "difference required for significance for "gross" sugar on basis of relationship between general means for "Gross" and "Recoverable" sugar.

(c **Calculated from the formula:**

$$S \text{ lbs. sugar} = \sqrt{\left(\frac{S \text{ lbs. beets}}{\text{Mean lbs. beets}}\right)^2 + \left(\frac{S \text{ \% sugar}}{\text{mean \% sugar}}\right)^2}$$

*Applies to Experiments reported on pages 142, 144, 170, 172, and 174.

COOPERATIVE AGRONOMIC EVALUATION TEST—1957

Fort Collins Experiment No. 1A

Conducted by: J. O. Gaskill and J. A. Elder.

Location: Hospital Farm, Fort Collins, Colorado; Field no. 2; under sprinkler.

Cooperation: Colorado Agricultural Experiment Station and Board of County Commissioners of Larimer County.

Date of Planting: May 3-8.

Date of Harvest: October 2.

Experimental Design: Triple lattice, twice; 6 replications.

Size of Plots: Four rows x 24'; rows 20" apart.

Harvested Area per Plot for Root Yield: An accurately measured length of row with satisfactory stand (in the row and adjacent to it) was harvested in each plot — usually approximately 30 ft. per plot. All harvested roots were topped, washed, and weighed.

Samples for Sucrose Determinations: Pulp from all roots harvested in any given plot was composited. Duplicate sucrose determinations were made, with a third determination in case the first 2 failed to agree satisfactorily.

Stand and Bolter Counts: Actual counts were made in the total harvest area of each plot, September 17.

Recent Field History: 1952, sugar beets; 1953-1956, alfalfa; fall plowed in 1956 following application of 2,4-D to kill alfalfa.

Fertilization of Beet Crop: Phosphate was applied just before fall plowing.

Leaf Spot Exposure: Very severe.

Black Root Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases: The only other disease of any consequence was sugar beet nematode. Generally its effects were mild. Areas of relatively severe effect were avoided at harvest.

Soil and Seasonal Conditions: Soil type--Fort Collins Loam, light textured phase. Stand was thin in parts of some plots due to crust at time of emergence. As indicated above, areas of poor stand were avoided at harvest. The field was sprayed twice with tractor sprayer using Parathion and Toxaphene for control of various insects. Early part of growing season was relatively cool and moist; the remainder, not far from normal. No severe freezes occurred before harvest. Furrow irrigation was adequate. The field was inoculated (*Cercospora beticola*) by means of 4-row tractor sprayer on July 23, using a spore suspension prepared from hand picked leaves from the 1956 crop. Periodic light sprinkling with water, was employed to promote development of leaf spot. Approximately 20% defoliation was caused by hail on August 17.

Reliability of Test: Acceptable.

COOPERATIVE AGRONOMIC EVALUATION TEST
EXPERIMENT NO. 1A - 1957, FORT COLLINS, COLORADO (UNDER SPRINKLER)
(Results given as 6-plot averages a/)

Description	Seed No.	Planting No.	Foliage Notes b/ Leaf Spot 1st 8/23	Leaf Spot 2nd 8/27	U	S	C	Stand (Hills per 100')	Bolters	Harvest Results Rts. per plot	Root Yield per A.	Suc.	Gross Suc. per A.
	Acc.							No.	%	No.	Tons	%	Lbs.
U-I 56-124,incr.of SP 55104-0	1370	16	4.0	4.3	5.3	4.8	5.3	112.7	0.00	35	7.14	12.33	1764
U-I 56-125,incr.of SP 5550-0	1371	10	5.2	5.0	5.7	5.0	5.5	107.7	0.00	31	6.31	12.31	1551
U-I 56-126,incr.of SP 5552-0	1372	14	4.8	4.4	5.5	5.2	5.0	112.5	0.00	34	7.40	11.98	1781
SLC 202H7, C.T. res.	1373	6	5.8	5.8	4.5	4.2	6.0	105.5	0.00	31	7.96	12.46	1991
F54-4H7, C.T. res.	1374	13	6.2	6.1	4.5	4.3	6.0	109.3	0.00	33	7.79	12.25	1904
WC 6305,U-I E/1 monogerm	1375	2	5.5	5.3	5.2	4.3	5.3	101.3	0.00	31	6.96	13.03	1813
C663H1(McF.);Non-bolt.C.T.res.hyb.	1376	9	6.2	5.9	4.7	4.3	5.8	107.3	0.00	32	7.35	12.35	1815
F56-66H2(McF.);Non-bolt.res.hyb.	1377	15	5.2	5.2	5.0	4.5	6.0	106.8	0.00	31	7.53	12.65	1902
WC 6200, incr. of SP 5510-0	1378	3	4.3	4.0	5.5	5.0	4.8	105.2	0.98	31	8.43	13.13	2215
WC 6327,incr.of WC 5215=Acc.2067	1380	8	2.9	3.0	5.7	6.2	4.8	102.8	0.53	31	7.50	13.10	1967
WC 6319,incr.of WC 5214=Acc.2066	1382	12	3.5	3.3	5.8	5.7	4.7	108.2	0.00	32	7.76	13.09	2032
WC 5354, US 401	2057	5	4.0	3.8	5.8	5.5	5.0	101.3	0.00	30	7.84	12.83	2007
WC 6203F & WC 6206F;(LSR-BRR,mm hyb.)	1396	11	3.6	3.2	6.3	5.7	4.8	101.5	2.70	29	7.53	12.80	1926
WC 6204F & WC 6207F;(LSR-BRR,mm hyb.)	1397	7	3.5	2.9	5.8	5.7	5.2	100.8	0.00	31	7.44	13.35	1988
WC 3216, incr. of 486-0	1327	4	6.3	6.0	5.0	4.0	5.7	113.2	0.00	34	7.17	11.88	1702
GW 359; 11856L5 (Local Check)	2073	1	3.5	3.8	6.2	5.8	5.2	109.2	0.00	33	9.55	13.22	2527
General Mean								106.58			7.6025	12.6724	1930.24
S.E. of Variety Mean								2.355			0.2579	0.2230	78.14
S.E. of Variety Mean as % of General Mean								2.21			3.39	1.76	4.05
L.S.D. (odds 19:1)								6.6			0.73	0.63	220

Variance Table — Experiment No. 1A—1957

Source of Variation	D/F	Mean Square (variance) Stand (Hills per 100')	Root Yield per Acre (tons)	Sucrose %	Gross Sucrose per Acre (lbs.)
Replications	5	177.17	0.7979	1.0287	61,488.4
Varieties	15	106.07	2.9408	1.2733	294,463.5
Error (remainder)	75	33.26	0.3990	0.2983	36,622.9
Total	95				
Calculated F value c/		3.19**	7.37**	4.27**	8.04**

a/ Actual, non-adjusted data only, are given; variance analyses performed by simple randomized complete block method.

b/ Foliage Notes (1st L.S. reading, 8/23/57; 2nd reading, 8/27/57):
Leaf Spot: 0 = no leaf spot; 10 = total defoliation.
Uniformity: low no. = uniform; high no. = irregular (in size, type, and color).
Size: low no. = small; high no. = large.
Color: low no. = light green; high no. = dark green.

c/ Symbol used to indicate significance of F values:
*: F equal to or greater than 5% point.
**: F equal to or greater than 1% point.

COOPERATIVE AGRONOMIC EVALUATION TEST — 1957

Fort Collins Experiment No. 10

Conducted by: J. O. Gaskill and J. A. Elder

Location: George V. Bachmayr Farm (6 mi. N.E. of Fort Collins, Colorado)

Cooperation: George V. Bachmayr and Colorado Agricultural Experiment Station.

Date of Planting: April 25-30

Date of Harvest: October 30-November 1.

Experimental Design: Triple lattice, twice; 6 replications.

Size of Plots: Four rows x 50'; rows 20" apart.

Harvested Area per Plot for Root Yield: Two inner rows x 46'; all roots topped, washed, and weighed.

Samples for Sucrose Determinations: Two 20-beet samples were taken at random from the harvest section of each plot, after lifting, and before piling and topping. Pulp from all roots of any given sample was composited. Duplicate sucrose determinations were made, with a third determination in case the first 2 failed to agree satisfactorily.

Stand and Bolter Counts: Actual counts were made in the 2 inner rows x 46', in each plot, on September 24.

Recent Field History: 1955, corn; 1956, summer fallow after cucumbers were hailed out.

Fertilization of Beet Crop: Phosphate, anhydrous ammonia and barnyard manure applied in 1956.

Leaf Spot Exposure: Negligible.

Black Root Exposure: Negligible.

Curly Top Exposure: Negligible.

Other Diseases and Pests: Effects negligible; infestations of cutworms, webworms, and grasshoppers controlled by insecticides. (see below)

Soil and Seasonal Conditions: Soil type--Weld Fine Sandy Loam, Valley Phase. The field was sprayed twice with Endrin by plane for control of cutworms, webworms, grasshoppers and other insects. The early part of the growing season was relatively cool and moist; the remainder not far from normal. No severe freezes occurred before harvest. Furrow irrigation was adequate.

Reliability of Test: Good.

COOPERATIVE AGRONOMIC EVALUATION TEST
EXPERIMENT NO. 1C - 1957, FORT COLLINS, COLORADO (BACHMAYR FARM)
(Results given as 6-plot averages[a])

Description	Seed No.	Planting No.	Foliage Notes[b] U	S	C	Stand (Hills per 100')	Bolters	Rts. per plot	Harvest Results: Root Yield per A.	Suc.	Gross Suc. per A.
	Acc.					no.	%	no.	tons	%	lbs.
U-I 56-124,incr. of SP 55104-0	1370	7	5.8	7.7	5.3	114.5	0.00	106	22.41	15.72	7031
U-I 56-125,incr. of SP 5550-0	1371	11	4.7	7.3	5.2	116.2	0.00	106	20.53	16.58	6808
U-I 56-126,incr. of SP 5552-0	1372	3	5.5	8.2	5.2	109.8	0.48	100	21.94	15.59	6837
SLC 202H7, C.T. res.	1373	2	5.3	7.3	7.0	110.5	0.00	102	25.65	16.91	8670
F54-4H7, C.T. res.	1374	14	6.0	7.5	6.7	114.8	0.00	105	25.05	16.53	8279
WC 6305, U-I E/1 monogerm	1375	13	5.8	8.0	5.3	116.0	0.00	106	21.94	17.21	7548
C663H1(McF.); Non-bolting C.T.res.hyb.	1376	1	5.3	7.8	6.8	114.8	0.00	107	24.90	16.88	8406
F56-66H2(McF.); Non-bolting res. hyb.	1377	4	5.2	7.5	6.3	105.8	0.00	99	22.71	17.84	8086
WC 6200, incr. of SP 5510-0	1378	16	6.0	8.0	4.3	111.3	5.05	103	22.54	16.54	7453
WC 6327, incr. of WC 5215=Acc.2067	1380	9	6.2	8.2	4.7	110.0	1.75	101	21.52	15.99	6880
WC 6319, incr. of WC 5214=Acc.2066	1382	8	5.7	7.7	4.7	115.0	1.77	105	21.95	16.18	7098
WC 5354, US 401	2057	15	5.7	8.2	4.7	117.0	4.98	104	21.05	15.95	6706
WC 6203F & WC 6206F;(LSR-BRR,mm hyb.)	1396	10	5.2	8.2	4.8	115.8	1.43	106	19.43	16.83	6540
WC 6204F & WC 6207F;(LSR-BRR,mm hyb.)	1397	12	4.5	8.3	4.8	113.8	0.32	105	18.99	16.55	6288
WC 3216, incr. of 486-0; Syn. ck.	1327	5	6.3	7.7	5.8	108.0	0.00	100	24.27	17.10	8284
GW 359; 11856L5 (Local Check)	2073	6	6.2	8.5	5.3	108.7	0.65	100	22.98	16.68	7665
General Mean						112.64			22.3661	16.5663	7411.10
S. E. Variety Mean						2.994			0.2675	0.2198	93.07
S. E. Variety Mean as % of General Mean						2.66			1.20	1.33	1.26
L. S. D. (odds 19:1)						8.4			0.75	0.62	262

Variance Table -- Experiment No. 1C-1957

Source of Variation	D/F	Mean Square (variance): Stand (Hills per 100')	Root Yield per Acre (tons)	Sucrose %	Gross Sucrose per Acre (lbs.)
Replications	5	17.89	5.9238	1.2732	434,948.2
Varieties	15	71.12	21.9805	2.0620	3,347,003.6
Error (remainder)	75	53.76	0.4293	0.2899	51,958.0
Total	95				
Calculated F value[c]		1.32	51.20**	7.11**	64.42**

a/ Actual, non-adjusted data only, are given; variance analyses performed by simple randomized complete block method.

b/ Foliage Notes (9/13/57):
Uniformity: low no. = uniform; high no. = irregular (in size, type, and color).
Size: low no. = small; high no. = large.
Color: Low no. = light green; high no. = dark green.

c/ Symbol used to indicate significance of F values:
* : F equal to or greater than 5% point.
** : F equal to or greater than 1% point.

Sugar Beet Variety Test, 1957
State College, New Mexico

Test conducted by Prof. J. C. Overpeck

Variety	Planted March 22			Planted April 17		
	Curly Top 1/		Tons 2/ per Acre	Curly Top 1/		Tons per Acre
	Aug. 3	Oct. 23		Aug. 3	Oct. 23	
SLC 333	3.8	4.7	22.61	4.0	4.5	18.48
SLC 202 H-9	2.0	2.3	28.64	2.2	2.3	31.68
SLC 509 H-6	2.3	2.3	27.78	1.7	2.2	30.53
F 55 - 92	2.3	2.5	24.94	2.5	2.3	26.96
Acc. 1370	2.7	2.3	26.05	2.5	2.5	26.83
Acc. 1371	1.7	1.8	26.84	2.2	2.2	27.06
Acc. 1372	2.2	2.5	27.39	2.2	2.3	25.98
SP 5654-0	2.7	3.0	25.45	2.2	3.0	27.67
LSD .05			7.97			3.84

1/ Curly top reading based on a scale of 0 = no damage and 6 = loss of plants due to disease. Disease readings given as 6-plot averages.

2/ Acre-yield of roots given as 3-plot averages. Planted as 6-replication experiment, but due to soil variation three replications not used in harvest results.

Polyploidy, Irradiations, and Species Hybrids and Methodology in Disease Exposure and Resistance Testing

INTRODUCTION

Investigations conducted at the Plant Industry Station, Beltsville, Md., with the support of the Beet Sugar Development Foundation, under Project 26, are concerned primarily with breeding for resistance to leaf spot and to black root in monogerm and in multigerm sugar beets. The results of the work have contributed to the accomplishments reported in Parts VII and VIII. Most of the greenhouse and field isolations at Beltsville for seed production in 1957 have been used for the increase of potential commercial monogerm varieties. The breeding research at the Plant Industry Station is a part of a large program of varietal improvement conducted with the cooperation of the Michigan Agricultural Experiment Station, East Lansing, Michigan; the Minnesota Agricultural Experiment Station, Waseca, Minnesota; the Farmers and Manufacturers Beet Sugar Association, Saginaw, Michigan; and other cooperators in the beet sugar industry. Significant improvement has been made in the last two years in the resistance of commercial type varieties to leaf spot as compared to the resistance of US 401, and improvement of breeding strains in resistance to black root has been noted from field and greenhouse tests. It is the purpose of this part of the report, however, to present results of some lines of basic research conducted at the Plant Industry Station with support under Foundation Project 26.

Studies Involving Cytological and Genetic Investigations

G. E. Coe

Polyploidy.--Tetraploid plants of several strains of sugar beets have produced small quantities of seed in their respective isolations. Among the strains used for tetraploid productions are SP 5480-0, SP 5511-0, and three inbred lines, which are resistant to black root and to leaf spot. These are all multigerm. There are also monogerm lines SP 5520-0 P.F. and SP 5520-01, its white anther equivalent. Tetraploid plants have been produced from SP 55104-0, SP 5552-0, and SP 5553-0, which are resistant to curly top and to leaf spot. Each of these lines is again being checked for chromosome number to insure that stable tetraploid lines are being produced. Enough seed of tetraploid SP 5553-0 was available to make a field selection in the 1957 nursery test. This tetraploid line, however, does not appear to be promising from the agronomic standpoint.

Irradiation Studies.--Genetic studies are being conducted with annual beets from which mutants were recovered after irradiation with thermal neutrons. Thus far, these mutations have not appeared to be inherited in a simple

Mendelian manner. Monogerm and multigerm sugar beet varieties have also been irradiated. Only the usual malformations resulting from irradiations were observed in the nursery in plants grown from irradiated seed. These plants will be crossed with nonirradiated plants and carried to the F_2 generation, in order that any beneficial mutation might have optimum opportunity for expression and the maximum chance to be observed.

Species Hybrids.--Several hybrids between tetraploid sugar beets and tetraploid *Beta patellaris* have been grown to maturity. Chromosome behavior during meiosis was not regular as might have been expected in an amphidiploid but was, to a large degree, irregular, indicating that *B. patellaris* is probably not an autotetraploid, as previously suspected, but is probably an allotetraploid. The irregular chromosome behavior resulted in poor production of pollen with varying chromosome numbers. Pollination of diploid and tetraploid *Beta vulgaris* plants with pollen from the hybrid has not resulted in the production of a single backcross plant. The hybrids did, however, produce about 100 fruits when pollinated with tetraploid sugar beet and tetraploid Swiss Chard pollen. Of these fruits, only six contained seeds that appeared to be plump and viable. Of these six seeds, only one germinated. Since it is probable that more success might be obtained with autotetraploid wild beets, production of these lines has been undertaken. Tetraploid plants have been found in the C_0 generation of colchicine treated plants of both *Beta procumbens* and *Beta webbiana*. C_1 generation plants of both of these species are growing in the greenhouse, and the chromosome numbers are being checked in the attempt to establish stable tetraploid lines. The chromosome number of triploid hybrids between tetraploid *Beta patellaris* and diploid *B. procumbens* has been doubled. C_1 generation plants in the greenhouse are being checked for chromosome number to determine whether or not a true amphidiploid hexaploid strain has been established. It is expected that these polyploid lines will be of value in the species hybridization program.

Backcrosses of a hybrid of B. trigyna ($2n = 36$) X tetraploid sugar beets to related plants of each of the parent species has indicated that healthy backcross plants result when the female parent species is used as the backcross pollinator, while weak chlorotic backcross plants are obtained when the male parent species is used as the backcross pollinator. This fact is being given more consideration in all of the species hybridizations between the distantly related members of the beet family. Since it is economically desirable to recover sugar beet types in a species hybridization, a sugar beet as the female parent is being emphasized.

Two interesting monogerm, white anther plants were found in a collection of *Beta maritima* seed made in 1948 in Wembury, South Devon, England. Genetic studies have been undertaken to determine whether or not this monogerm characteristic is the same as the monogerm gene of SL 101 and to determine the nature of the pollen sterility.

Studies on Black Root Caused by *Aphanomyces cochlioides*

C. L. Schneider

Studies on the pathogenicity of Aphanomyces cochlioides.--Six single-spore isolates of the black root fungus from Montana, Minnesota, and Maryland differed in ability to sporulate and in ability to attack different sugar beet strains, spinach, and peppers. There was no interaction between fungus isolates and host strains; that is, the relative reaction of the host strains to each isolate was similar. Two isolates grown continuously on laboratory media for 5 years were as virulent as isolates recently cultured, whereas one was less virulent.

Hosts other than sugar beet, including different forms of *Beta vulgaris*, were inoculated with the black root fungus to seek new factors for resistance, to seek differential hosts for determination of physiologic specialization of the pathogen, and to determine the effect of other hosts on the black root potential of the soil. Several varieties of garden beets, mangels, and Swiss Chard differed considerably in susceptibility to black root, but none were quite as resistant as US 400 and related strains.

Methods studies on black root exposures.--Tests were continued to develop a methodology for controlled exposures of sugar beet seedlings to *A. cochlioides* in the greenhouse and laboratory. Quantity of zoospore inoculum and age of plants, when inoculated, affect the incidence and severity of black root. As shown in Fig. 6, there is considerable range between the limits of both of these factors which will permit differentiation between resistant and susceptible varieties at the different age of seedlings.

In comparative tests with polycrosses, there were statistically significant differences among entries in incidence and severity of black root expressed as a percentage value. The relative performances of the same entries in a subsequent test gave concordance between tests, as shown in Fig. 7.

The reaction of sugar beet polycrosses to *Aphanomyces* was indicative of their relative performance in the field under moderately severe natural black root exposure. As shown in Fig. 8, the greenhouse black root ratings of 41 polycross progenies were significantly correlated with their root weights in the black root nursery at Waseca, Minnesota, in 1956. Similarly, there was a significant correlation between greenhouse ratings and field performance in 1957 of 40 progenies.

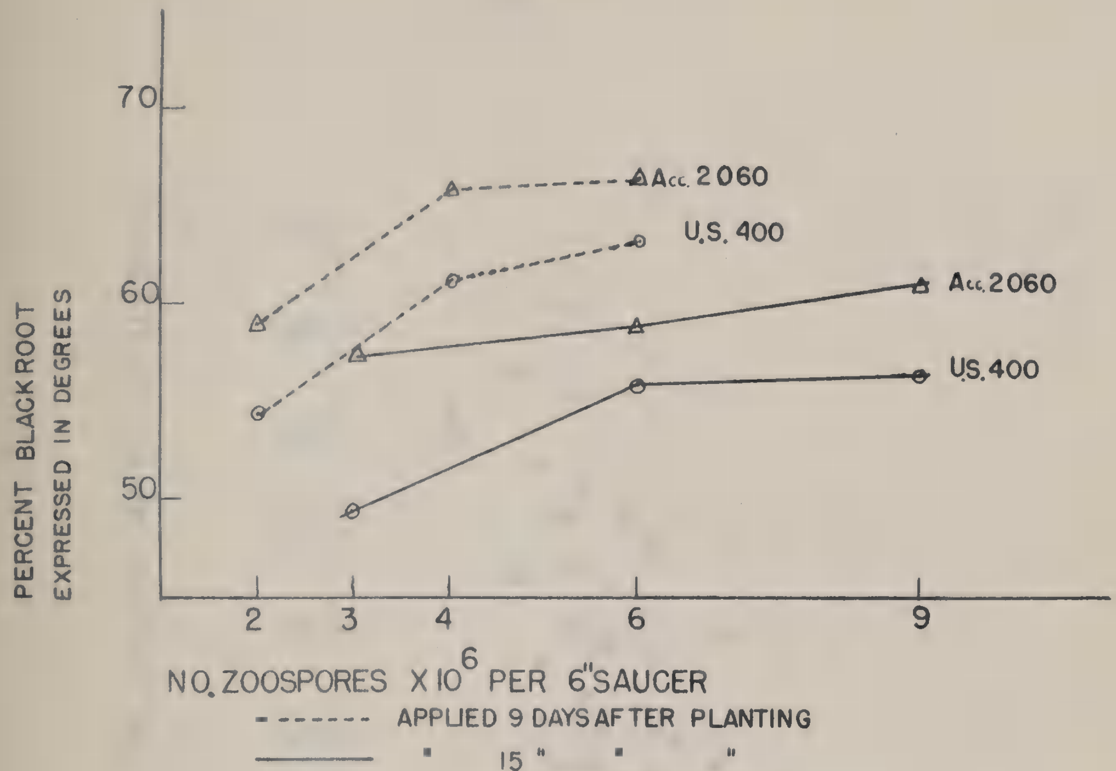

Fig. 6.--Effect of zoospore concentration and age of plant inoculated with Aphanomyces cochlioides on development of black root on resistant variety US 400, and susceptible variety Acc. 2060.

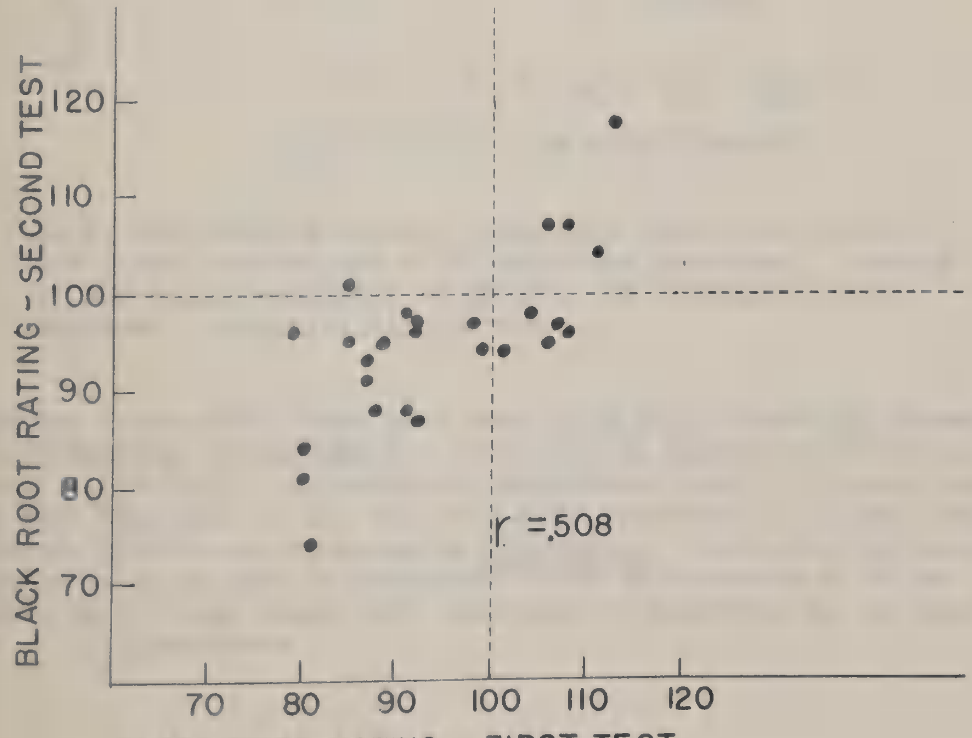

Fig. 7.--Black root ratings of 26 sugar beet strains as evaluated in two greenhouse tests. Lowest numerical rating indicates highest resistance to black root, with 100 equal to that of US 400.

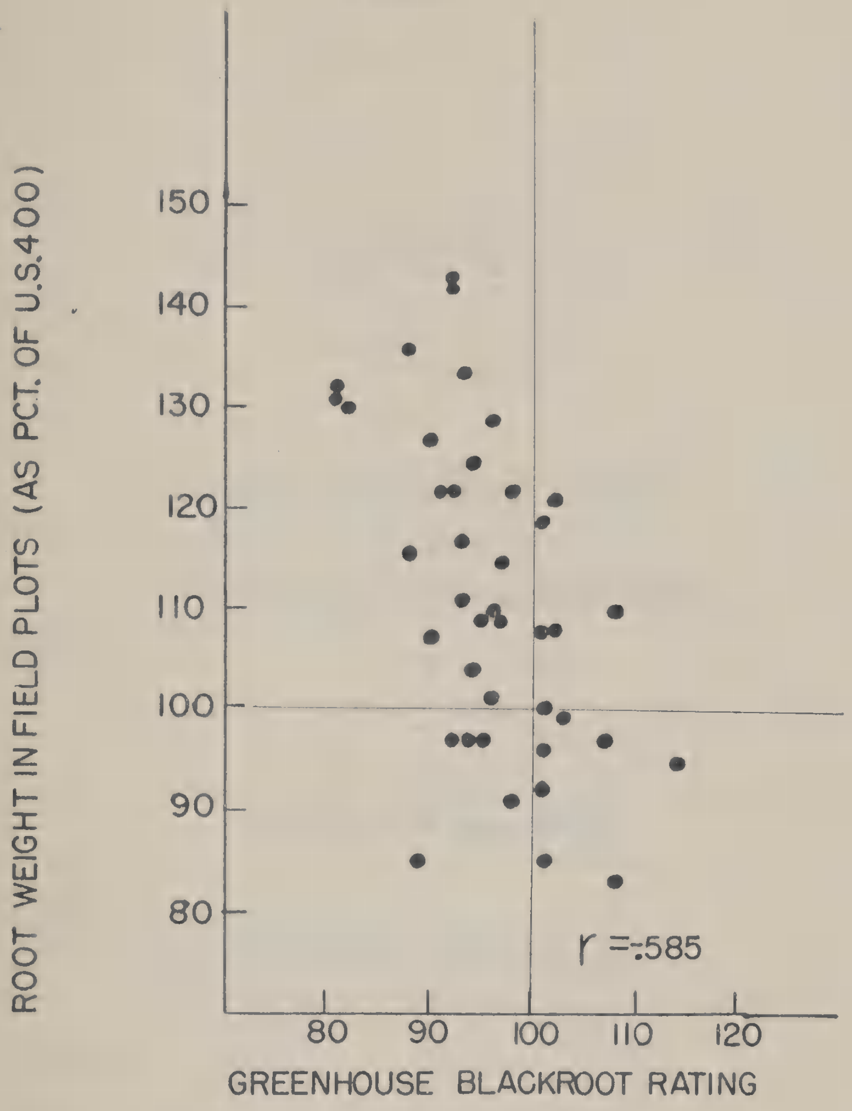

Fig. 8.--Correlation between greenhouse black root ratings and field root weights of 41 polycross progenies. Ratings of 100 equal resistance of US 400. As numerical ratings increase, susceptibility increases.

Greenhouse inoculation tests have been found to be useful in screening of large numbers of seedlots for resistance to black root prior to testing in the field. In addition, selections in multigerm and monogerm lines have been made of the most resistant appearing individuals surviving severe greenhouse exposures to Aphanomyces. Evaluation of their progenies is to be made in subsequent tests to determine if it is possible to increase black root resistance by selection in the seedling stage in the greenhouse.

PART X

MONOGERM SELF-FERTILE LINES
and
CYTOPLASMIC MALE-STERILE EQUIVALENTS
of
MONOGERM LINES

- -

POLYPLOIDY IN SUGAR BEETS

- -

INTERSPECIFIC HYBRIDIZATIONS

Supported under Foundation Project 11

V. F. Savitsky Helen Savitsky

Geneticist and Cytologist, Beet Sugar Development Foundation; and Collaborators, Crops Research Division, A.R.S., U.S.D.A., working under the supervision of the Sugar Beet Section, Salt Lake City, Utah.

TEST OF 24 MONOGERM SELF-FERTILE LINES

By V. F. Savitsky

Twenty-four self-fertile monogerm inbred lines were tested in Taylorsville, Utah (Test 6, Project 23), and in Twin Falls, Idaho (Test 5, Project 22), in 1957. In both locations the test was conducted with three replications.

All inbred lines were derived from backcrosses of ten different self-fertile monogerm lines to four curly-top-resistant varieties, US 22, US 34, US 104 and US 75.

In comparison with the variety US 41, which was used as a check, six self-fertile monogerm lines (Nos. 127, 126, 122, 333, 321, and 1273) showed significantly higher sucrose percent than US 41 in Idaho. Six of these lines also had significantly higher sucrose percent than US 41 in Utah tests.

The majority of these high-sugar monogerm lines originated from crosses of the multigerm variety US 22 with monogerm lines SLC 600 and SLC 803. High sugar content in both these lines was confirmed in experiments for genetic study of sucrose percent in monogerm beets in 1955-1956. Therefore, these two lines are valuable for further improvement of sucrose percent in monogerm hybrids.

One line (No. 333), derived from hybridization of US 104 and SLC 91, also showed significantly high sucrose percent.

INTERSPECIES HYBRIDIZATION BETWEEN BETA VULGARIS L. AND A SPECIES OF THE SECTION B. PATELLARES TR.

By H. Savitsky

1. Hybridizations were made between B. patellaris (4n), 4n sugar beets, and 4n Swiss Chard. B. webbiana and B. procumbens were crossed to 4n and 2n Swiss Chard.

2. A study was made of meiosis in the F_1 hybrid between the Turkish leaf beet (2n) and B. procumbens (2n) obtained by Dr. R. K. Oldemeyer.

The F_1 hybrid was semi-fertile. The degree of pairing of chromosomes in this hybrid was but little higher than in the completely sterile hybrid Swiss Chard (2n) X B. webbiana (2n) produced by Mr. J. O. Gaskill. Chiasma frequency in a semi-fertile hybrid with B. procumbens was estimated at 3.6 instead of 3.04 for the sterile hybrids with B. webbiana. Therefore, a certain degree of fertility in the hybrid studies was not due to better pairing of chromosomes.

The first division in the hybrid with B. procumbens was quite regular. The bivalents divided and their partners proceeded to the opposite poles; the univalents divided, too. Almost all or all univalents divided in the first division. The distribution of chromosomes was quite regular, and in 38 percent of the P.M. cells the distribution was equal. Both interkinetic nuclei contained the same number of chromosomes, for instance, 18:18; 14:14; 13:13; 12:12; etc. Two interkinetic nuclei with 18 chromosomes arose because of the division of all 18 univalents in the asynaptic nuclei. Laggards were observed in only 18 percent of the cells. The number of chromosomes in P.M.C. at the first anaphase and at interkinesis varied from 23 to 36.

At the second metaphase and anaphase only a few chromosomes divided. The division and separation of chromosomes was irregular. In the second division only the partners of the bivalents and some univalents which did not divide in the first division divided. Perhaps only a few univalents divided the second

time. The number of chromosomes in P.M.C. varied at the second anaphase and tetrad stage from 27 to 41. Only five chromosomes were in excess as compared with the number of chromosomes after the first division. Breakage of chromosomes was observed at prophases. Bridges, telocentric and accentric fragments were observed.

The number of chromosomes in the nuclei at the tetrad stage varied from 1 to 20. Only diploid gametes (18 chromosomes) and the gametes with the number of chromosomes approaching diploid were viable. The first backcross progeny contained 26, 27, 28, and 30 chromosomes. The majority of backcross hybrids were triploid.

Higher fertility in the hybrid Turkish leaf beet X B. procumbens was due to the division of univalents and the regular distribution of chromosomes in the first meiotic division. Because of the regular division of univalents, the composition of chromosome sets in the gametes approached the composition of a non-reduced gamete. These gametes contained complete or nearly complete haploid sets of chromosomes of either species involved in a hybridization.

Investigation of meiosis showed that these hybrids could not survive on the diploid base. Therefore, it will be desirable to involve polyploid races of B. vulgaris L. in hybridizations with species of the section Patellares.

POLYPLOIDY IN SUGAR BEETS

By H. Savitsky and V. F. Savitsky

1. Production of new tetraploid strains:

New tetraploid strains were produced from the following varieties and strains:

a. U.S. 401 black root and leaf-spot resistant

b. U.S. 104 curly-top and leaf-spot resistant

c. Self-sterile monogerm population No. 15

d. Monogerm inbred line No. 531-7

In 1957 chromosome numbers were investigated in the C_1 generation of all these strains (about 1,000 plants were examined). Tetraploid plants were selected and propagated in isolation, and tetraploid seed harvested from each tetraploid strain.

2. Propagation of tetraploid strains:

a. 4n self-fertile line SLC 91 mm was propagated, together with a 4n monogerm male-sterile strain.

b. 4n self-fertile line SLC 610 mm was propagated.

c. A 4n self-sterile monogerm population was propagated.

d. 4n F_1 hybrids between 4n self-fertile inbred monogerm X 4n self-sterile multigerm beets, as well as F_1 hybrids between 4n self-sterile monogerm X 4n self-sterile multigerm, were propagated to obtain F_2 seed.

VARIATIONS OF SUCROSE PERCENT AND YIELD IN DIFFERENT CYTOPLASMIC MALE-STERILE EQUIVALENTS OF THE INBRED LINE SLC 610 mm AND IN F_1 HYBRIDS OBTAINED FROM THESE EQUIVALENTS

By V. F. Savitsky

Cytoplasmic male-sterile races were isolated in different multigerm varieties after their hybridization with SLC 101 mm and other monogerm lines which do not restore pollen fertility in male-sterile beets.

All these male-sterile races carried cytoplasm of different origin. Each male-sterile race carried the cytoplasm of the variety from which it originated.

Experiments conducted for eight years showed that all new monogerm male-sterile races which appeared in hybrid lines belonged to the cytoplasmic male-sterile type, which is modified by the action of the nuclear genes. This type of male-sterility was first described by F. V. Owen.

Many of these new male-sterile lines differed in the grade of male-sterility, as well as in the reaction to the nuclear genes which restored male-fertility in male-sterile races. Among them many perfect male-sterile lines were found which could be propagated on a large scale for obtaining commercial male-sterile hybrids.

The cytoplasmic monogerm male-sterile races were obtained in hybrids from the following varieties: Janash, Kleinwanzleben ZZ, US 201B, US 201, US 104, US 216, US 35/2, US 22/3 and mangel variety Vini Vidi Vici. All male-sterile lines which were developed from these races started from a single plant which was crossed to monogerm beets.

To control the male-sterility, new male-sterile races selected from different varieties were planted in an isolation and pollinated for several years by the same inbred line which did not restore male-fertility. Because of eight continuous backcrosses to the same genotype, the genetic differences between these male-sterile races decreased very fast and differences noticed

now may be attributed to hereditary differences in the plasm, rather than to the different genes determining different manifestation of the same characters in different lines.

If the differences in expression of the same characters (for example, percent sucrose), in the original ancestors (pedigree plants) was caused by not more than 50 or 100 genes, then after eight backcrosses to the same genotype these lines can be distinguished only a little from each other (or cannot be distinguished at all) and all must be similar to their recurrent parent.

Richey (1927) gave a formula for the calculation of percentage of homozygotes in the backcrosses of inbred lines $\frac{(2^r-1)^n}{2^r}$ where "r" is the number of generations and "n" the number of pairs of genes.

After eight backcrosses to recurrent inbred the percentage of homozygotes for "n" genes in the progeny must be as follows:

NUMBER OF PAIRS OF GENES	PERCENT
1	100
5	98
10	96
15	94
20	92
40	86
50	82

Diploid beets have nine pairs of chromosomes. Every tenth gene must be linked with another one, even in a small degree. Therefore, by numerous backcrosses (8) to the recurrent inbred line, the process of increasing the identity in the genetic structure between backcross

hybrids and the recurrent inbred line will be even greater than shown in the above table.

It is well-known in beets, and in other plants too, that male-sterility and different chlorophyll deficiencies are controlled by plasmatic inheritance. Besides this Schlösser indicates that triploid reciprocal hybrids between sugar beets and mangels differed in sucrose percent and in yield of roots.

The question concerning the number of necessary backcrosses for the development of male-sterile equivalents for several lines is new in sugar beet breeding. As far as we have at our disposal several male-sterile races differing in the origin of male-sterile plasm, it will be interesting to learn which of these races will be the most valuable in sugar beet breeding. What will be the possible influence of the male-sterile equivalent on the expression of sucrose percent and yield as in the male-sterile equivalent itself and in the F_1 hybrids?

Sucrose percent and yield were studied in six male-sterile equivalents of the inbred line SLC 610 mm. The six male-sterile equivalents carried different male-sterile cytoplasms originating from the following varieties: Klein Z, US 22/3, Janash, US 35/2, US 216 and fodder beet Vini Vidi Vici.

An experiment was planted in 1957 in twelve replications and included twelve different varieties; in other words, it was planted as a Latin Square. Male-sterile lines with male-sterile cytoplasm of different origin differed in vigor during the summer. Evaluation of root yield showed that cytoplasmic male-sterile equivalents differed significantly in the yield of roots(table 1).

Differences in yield between extreme male-sterile equivalents equaled 4.90 tons per acre. The male-sterile equivalent originating from the variety Klein Z gave 22.1 tons beets per acre, and the male-sterile equivalent from Vini Vidi Vici produced only 17.2 tons. Therefore, the male-sterile equivalent

which carried the cytoplasm from the variety Klein Z exceeded the male-sterile equivalent with cytoplasm from Vini Vidi Vici by 128.488 percent.

Differences between male-sterile equivalents carrying cytoplasm from different sugar-beet varieties were also highly significant. In absolute value this difference equaled 2.0 tons. In percent the male-sterile equivalent with cytoplasm from Klein Z exceeded its male-sterile equivalent with cytoplasm from US 216 by 109.95 percent.

Differences between male-sterile equivalents in gross sugar are also significant (table 5). Differences among male-sterile equivalents were estimated at 1372 lbs. per acre. In percentage the best male-sterile equivalent from Klein Z exceeded the poorest one by 26.184 percent.

Differences between male-sterile lines in sucrose percent are not so great as in the weight of roots, but they are significant. These differences in absolute value equaled 0.70 percent of sucrose (table 5).

The highest sucrose percent showed a male-sterile equivalent from the variety Janash (15.3 percent) and the lowest the male-sterile equivalent from US 35/2 (14.6 percent). It is interesting to note that both these male-sterile equivalents had almost the same root weight (20.4 and 20.9 tons per acre).

<u>Variation in sugar and yield in F_1 hybrids between two inbred lines, dependent upon the origin of male-sterile plasm in female parents and male-sterile equivalents of these inbreds.</u>

Four male-sterile equivalents of inbred SLC 610 mm, which carried the cytoplasm from the varieties Janash, Klein Z, US 216 and Vini Vidi Vici, were pollinated in an isolation plot by the inbred line SLC 91 mm. In this way four F_1 hybrids were obtained between inbreds 610 and 91 (table 2).

The excess in weight of roots of different F_1 hybrids in comparison to the average yield of two parental inbred lines, varied from 124 to 136 percent. Differences in tons of beets per acre varied in F_1 hybrids from 22.4 to 24.0; in other words, the difference equaled 1.6 tons per acre. At the same time, the significant difference for the 1% point equals only 0.80 tons per acre.

In this way all F_1 hybrids exhibited heterosis in the weight of root, but the grade of its manifestation was different in different male-sterile monogerm equivalents. The highest manifestation of heterosis was observed in the male-sterile equivalent with cytoplasm from the variety Janash.

Differences in sucrose percent in F_1 hybrids were also great. The difference in sucrose percent between the highest and the lowest F_1 hybrid equaled 1.3 percent. At the same time, the significant difference for the 1% point was only 0.78 percent.

These big differences in sucrose percent are conditioned by positive heterosis in sucrose in certain F_1 hybrids and by negative heterosis in other F_1 hybrids.

F_1 hybrids obtained by pollination of the male-sterile equivalent with cytoplasm from the variety Janash and Klein Z showed positive heterosis. The difference in sucrose percent between the F_1 hybrid with plasm from Klein Z with average sucrose percent in the parents,equaled 0.6 percent. At the same time the F_1 hybrid with cytoplasm from fodder beet Vini Vidi Vici showed 13 percent sucrose. In comparison with the average sucrose percent of the parents the loss in sugar equals 0.7 percent.

Experimental data obtained in 1957 showed that sugar and yield in the same hybrid combination were different depending on the origin of plasm in the male-sterile equivalents obtained by numerous backcrosses to a given inbred line. In this way the productiveness of commercial hybrids will

depend upon (1) the genetic value of plasm in the line carrying the male-sterile character used for the development of the male-sterile equivalent of the inbred line. (2) The genotype of the monogerm inbred line by means of which the elite male-sterile monogerm seed was obtained. (3) The pollinator which was chosen for production of commercial monogerm seed.

A study of the behavior of cytoplasm in B vulgaris must be continued. If the influence of nuclear genes on sugar percent, weight of root, and other characters, depends not only upon a genetic balance in the nucleus but also upon their interaction with hereditary peculiarities of plasm, then many breeding problems in beets must be revised.

Therefore, basic research must include not only inheritance of the elements of the nucleus, but also the inheritance of plasm.

I express my gratitude to Mr. C. H. Smith and to Mr. G. K. Ryser for conducting the field test of male-sterile equivalents and for statistical calculation of the experiment in 1957.

TABLE 1 -- SUGAR PERCENTAGE AND YIELD IN MALE-STERILE EQUIVALENTS OF INBRED SLC 610 [redacted] WITH PLASM OF DIFFERENT ORIGIN.
MS lines were obtained after eight backcrosses with monogerm beets.
TAYLORSVILLE, UTAH, 1957

CODE NO.	ORIGIN OF PLASM	ACRE YIELD GROSS SUGAR LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE
8337	Klein Z	6,612	22.1	14.9
610	US 22/3	6,492	22.0	14.8
9333	Janash	6,268	20.4	15.3
9512	US 35/2	6,140	20.9	14.6
216	US 216	6,092	20.1	15.1
9563	Vini Vidi Vici	5,240	17.2	15.2
Difference		1,372	4.9	0.70
Sig. Diff. (19:1)		654	0.60	0.59
Sig. Diff. for 1% point		864	0.80	0.78

TABLE 2 -- SUGAR PERCENTAGE AND YIELD IN F_1 HYBRIDS BETWEEN TWO MONOGERM INBRED LINES (SLC 610 mm AND SLC 91 mm) TO CORRESPOND WITH ORIGIN OF PLASM IN MALE-STERILE EQUIVALENTS OF INBRED SLC 610 mm

CODE NO.	ORIGIN OF	ACRE YIELD GROSS SUGAR LBS.	ACRE YIELD TONS BEETS	PERCENT SUCROSE	$\frac{\text{SL 91 + SL 610}}{2}$ ACRE YIELD GROSS SUGAR %	$\frac{\text{SL 91 + SL 610}}{2}$ ACRE YIELD TONS BEETS %	$\frac{\text{SL 91 + SL 610}}{2}$ SUCROSE %
(9333 X 610) X 91	Janash	7142	24.0	14.9	138.41	135.97	101.71
(8337 X 610) X 91	Klein Z	6822	22.4	15.2	132.21	126.91	103.75
(216 X 610) X 91	US 216	6726	23.7	14.2	130.34	134.27	96.93
(9563 X 610) X 91	Vini Vidi Vici	6292	22.5	13.9	121.93	127.47	94.88
Difference		850	1.6	1.3			
Sig. Diff. (19:1)		654	0.60	0.59			
Sig. Diff. for 1% point		864	0.80	0.78			
SLC 610 mm inbred		5286	17.7	14.9			
SLC 91 mm inbred		5036	17.6	14.4			
MEAN $\frac{610 + 91}{2}$		5036	17.65	14.6	100.00	100.00	100.00
US 41 population		6995	27.6	13.65			